United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Missouri Agricultural
Experiment Station

Soil Survey of Lewis County, Missouri

How To Use This Soil Survey

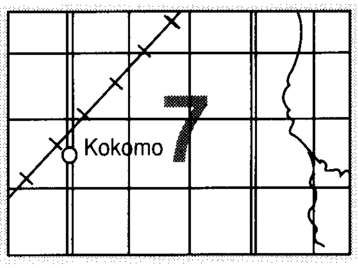
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

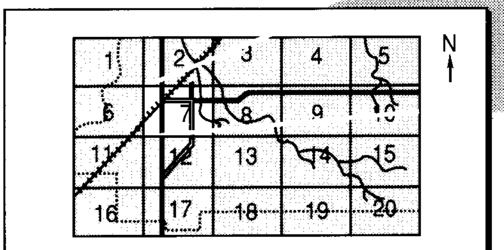
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



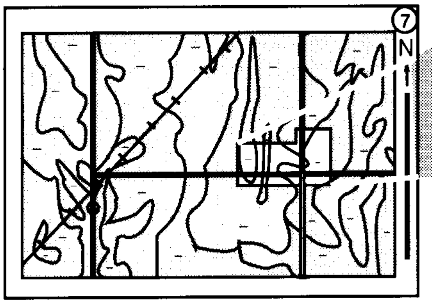
MAP SHEET

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



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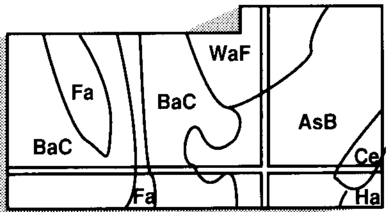

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources provided a soil scientist to assist in soil mapping. The Lewis County Court provided funds for equipment and supplies. The survey is part of the technical assistance furnished to the Lewis County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: A pond, a pasture, and oak-hickory woodland in an area of Lindley loam, 14 to 20 percent slopes.

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Issued August 1992

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Lewis County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Missouri University Extension Service.

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Soil Survey of Lewis County, Missouri

By F. Conrad Watson, Soil Conservation Service

Fieldwork by F. Conrad Watson and Carol A. Bartles, Soil Conservation Service, and Gary M. Noel, Missouri Department of Natural Resources

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Missouri Agricultural Experiment Station

LEWIS COUNTY is in the northeastern part of Missouri (fig. 1). It is bordered on the east by the Mississippi River. It has a total area of 326,924 acres, or about 510.8 square miles. This acreage includes 1,472 acres of water areas more than 40 acres in size.

Farming is the main enterprise in the county. The main crops are corn, soybeans, winter wheat, and grasses and legumes. The chief kinds of livestock are hogs and beef cattle. A few farms have herds of dairy cattle.

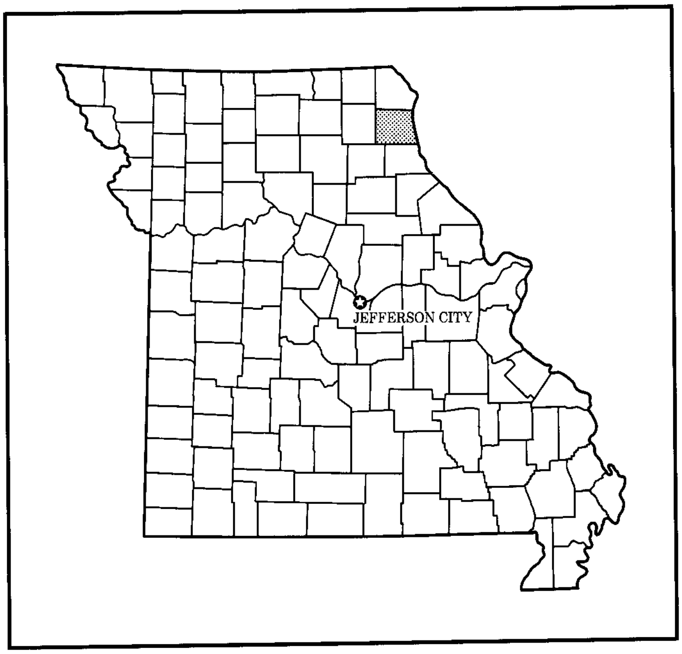

Figure 1.—Location of Lewis County in Missouri.

General Nature of the County

This section gives general information about the county. It describes climate, natural resources, relief and drainage, settlement and population, and transportation facilities and industry.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

The consistent pattern of climate in Lewis County is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer, when moist air from the Gulf of Mexico interacts with drier continental air. The amount of annual rainfall is normally adequate for corn, soybeans, and all of the grain crops commonly grown in the county.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Steffenville, Missouri, in the period 1951 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 28 degrees F and the average daily minimum temperature is 19 degrees. The lowest temperature on record, which occurred at Steffenville on February 9, 1979, is -20 degrees. In summer, the average temperature is 74 degrees and the average daily maximum temperature is

86 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 111 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 35.57 inches. Of this, nearly 24 inches, or about 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 5.48 inches at Steffenville on August 5, 1970. Thunderstorms occur on about 45 days each year. Tornadoes and severe thunderstorms occur occasionally but are local in extent and of short duration. They cause varying amounts of damage in small areas. Hailstorms occur in scattered small areas at times during the warmer part of the year.

The average seasonal snowfall is about 27 inches. The greatest snow depth at any one time during the period of record was 20 inches. On the average, 24 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 65 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

Natural Resources

Soil is the most important natural resource in Lewis County. Many marketable products are derived, either directly or indirectly, from the soil. These include crops, livestock, wood, fruits, vegetables, and honey. In many areas the soils are suitable for many kinds of construction and are sources of sand, topsoil, and gravel.

The mineral resources in the county include limestone, sand, gravel, coal, and shale. Two limestone quarries provide agricultural lime and gravel for roadways. A gravel pit south of LaGrange is mined for sand and gravel, which are used as building material and as material for roadways. The county has small areas of coal, but these have little potential for development.

Relief and Drainage

Lewis County includes several major physiographic regions. The alluvial flood plain along the Mississippi River parallels the eastern boundary. The strongly sloping areas adjacent to this flood plain are deep, loess-covered hills that have narrow bands of glacial till on the lower slopes. The rest of the county is dissected by several streams and their accompanying flood plains, which divide the county from northwest to southeast. Adjacent to the flood plains are timbered areas characterized by strongly sloping hills of glacial till and thin deposits of loess on narrow ridges. The broad ridges between the major drainage areas are wide expanses of gently sloping, loess-covered prairies.

Elevation ranges from 470 feet above sea level in an area on the flood plain along the Mississippi River in the southeast corner of the county to 760 feet in the west-central part of the county.

All of the surface water in the county drains into the Mississippi River and its tributaries. The major tributaries are the North Fabius River, the Middle Fabius River, the South Fabius River, the Wyaconda River, Sugar Creek, Grassy Creek, Troublesome Creek, Durgens Creek, and Buck and Doe Run Creeks.

Two watershed projects, Durgens Creek and Buck and Doe Run Creeks, have been completed in the county. These are designed for watershed protection and flood prevention. The county has three organized drainage districts—Union, Fabius, and Gregory. Each has its own pumping plant. The county has two artesian wells, one near LaGrange and the other north of Canton.

Settlement and Population

The first settlers in the survey area were the American Indians and their ancestors. At the time of European exploration, the Fox and Sac Tribes favored the area as a hunting ground.

The French claimed the survey area in 1712. The area was ceded by France to Spain in 1762 and retroceded to France in 1801. The Louisiana Purchase, in 1803, turned the area over to the United States.

The Fox and Sac Indians signed treaties with the United States in 1804 and 1816. Both treaties indicated that the United States claimed the survey area but designated the area north of the Fabius River and 30 miles west of the mouth of the Fabius River as Indian territory. In 1818, the Federal Government surveyed a 6-mile-wide strip that extended all the way to the Des Moines River, crossing the treaty boundary. This survey was done 6 years before the treaty expired. In 1824, the last treaty was signed, turning the survey area over to the United States for settlement. The Missouri, Osage, Sac and Fox Tribes were removed to reservations about 1840 *(9)*.

In 1795, during Spanish possession, Godfrey LeSeur, a Frenchman, established a trading post near the mouth of the Wyaconda River. The post was abandoned during the winter months. The first permanent settlement was south of LaGrange. It was established in 1819. The first settlers came from Kentucky and Virginia. Settlement first occurred near the Mississippi River and in the adjacent river hills. Later, settlers moved into the interior of the county. Soon after the settlers arrived, farming became the economic base of the survey area. Corn, winter wheat, and livestock were major sources of income. As the population increased and the economic base stabilized, a county government was formed and churches and schools were built.

When the county was established in 1833, it included not only what is now Lewis County but also Clark, Knox, and Scotland Counties. The original county had a population of about 600 in 1833. The present boundaries were established in 1845. In 1850, the population of the county was 6,578. In 1900, it was 16,724. By 1940, it had decreased to 11,490 *(16)*. In 1980, it was 10,901 *(6)*.

Transportation Facilities and Industry

Lewis County has good transportation facilities. The major highways are U.S. Highway 61 and State Highways 6, 16, 81, and 156. Nearly every rural road is graveled. The county is served by three truck lines. Barges transport many goods up and down the Mississippi River. A ferry at Canton transports many vehicles and agricultural goods across the Mississippi River into Illinois.

Many industries in the county provide goods and services. They employ more than 350 workers. The chief products of these industries are concrete, mining equipment, oil-drilling equipment, newspaper printing, crushed and broken stone, sand, telephone parts, and pickle separators *(4)*.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are named and mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of soils on one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions, names, and delineations of the soils on the general soil map of this county do not fully agree with those on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping the soils separately and giving them different names.

Soil Descriptions

1. Kilwinning-Putnam Association

Gently sloping and nearly level, poorly drained soils formed in loess; on uplands

This association is on broad upland divides that have long side slopes and narrow, branching drainageways. Slopes range from 0 to 5 percent.

This association makes up about 21 percent of the county. It is about 68 percent Kilwinning soils, 23 percent Putnam soils, and 9 percent minor soils (fig. 2).

Kilwinning soils are gently sloping and are on side slopes and narrow ridgetops. Typically, they have a surface layer of very dark grayish brown silt loam. The subsoil is dark gray and dark grayish brown, mottled silty clay in the upper part and gray, mottled silty clay loam in the lower part.

Putnam soils are nearly level and are on the highest part of the landscape. Typically, they have a surface layer of very dark grayish brown silt loam and a subsurface layer of grayish brown, mottled silt loam. The upper part of the subsoil is dark grayish brown, mottled silty clay; the next part is grayish brown, mottled silty clay; and the lower part is light brownish gray, mottled silty clay loam.

Minor in this association are the moderately sloping, moderately well drained Armstrong soils on the lower side slopes.

Nearly all of this association is used for corn, soybeans, or wheat. Some small areas are used for hay and pasture.

Controlling water erosion and improving or maintaining fertility and tilth are the main concerns in managing the gently sloping areas for crops. Wetness is the main concern in the nearly level areas. It hinders tillage and harvesting in most spring and fall months.

The major soils are suited to pasture. The hazard of water erosion caused by overgrazing is the main concern in managing the gently sloping areas for pasture. Wetness is a management concern in the nearly level areas.

The major soils are suitable for building site development and some sanitary facilities. A high shrink-swell potential in the clayey subsoil, wetness, and low strength are the main limitations affecting building site development. Sewage lagoons can function satisfactorily in the nearly level areas.

2. Armstrong-Leonard Association

Moderately sloping, moderately well drained and poorly drained soils formed in pedisediments and weathered glacial till and in loess and pedisediments; on uplands

This association is on ridgetops, on side slopes, and at the head of drainageways. Slopes are short and are dissected by drainageways. They range from 5 to 9 percent.

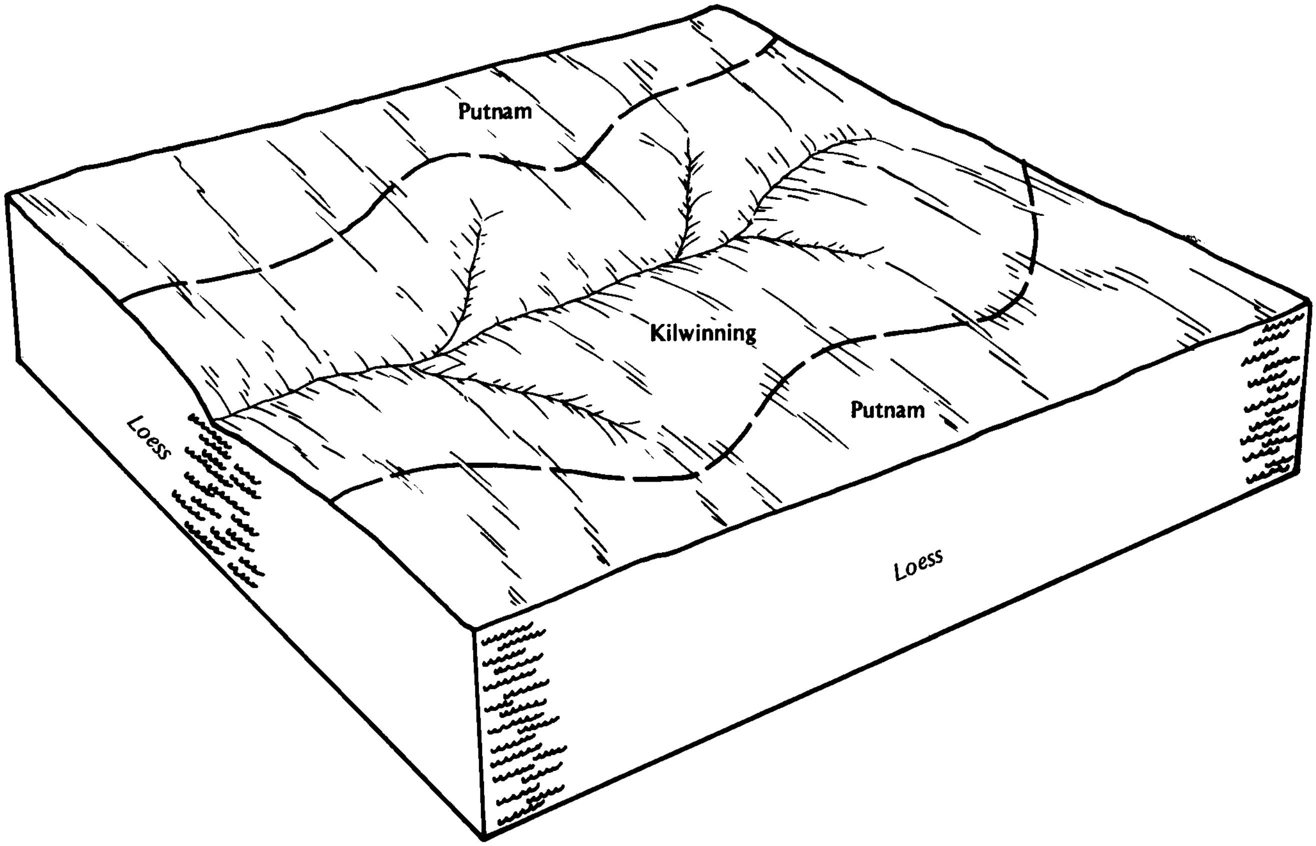

Figure 2.—Typical pattern of soils and parent material in the Kilwinning-Putnam association.

This association makes up about 14 percent of the county. It is about 50 percent Armstrong soils, 22 percent Leonard soils, and 28 percent minor soils.

Armstrong soils are moderately well drained. Typically, they have a surface layer of very dark grayish brown loam. The upper part of the subsoil is brown and dark brown, mottled clay loam; the next part is strong brown, mottled clay; and the lower part is yellowish brown, mottled clay loam. The substratum is yellowish brown, mottled clay loam.

Leonard soils are poorly drained. Typically, they have a surface layer of very dark grayish brown silty clay loam. The subsoil is silty clay. The upper part is dark grayish brown and mottled, the next part is gray and mottled, and the lower part is mottled grayish brown and light olive gray.

Minor in this association are Keswick and Lindley soils. Keswick soils are in strongly sloping areas, and Lindley soils are on moderately steep side slopes.

About 60 percent of this association is used for corn, soybeans, or wheat. The rest is used for pasture, hay, or trees.

Controlling water erosion and improving or maintaining fertility and tilth are the main management concerns in the areas used for crops. The hazard of water erosion caused by overgrazing is the main concern in managing pasture.

The major soils are suitable for trees. Only the areas that are too steep or uneven for farming remain wooded. The existing stands are dominantly oak and hickory.

The major soils are suitable for building site development and some sanitary facilities. Slow permeability, the slope, wetness, a high shrink-swell potential in the clayey subsoil, and low strength are the main limitations.

3. Keswick-Lindley-Gorin Association

Moderately sloping to steep, moderately well drained and somewhat poorly drained soils formed in pedisediments and weathered glacial till, in glacial till, and in loess and pedisediments; on uplands

This association is on narrow ridgetops and side slopes. Valleys are deep and are commonly less than ⅛ mile wide. Slopes range from 5 to 35 percent.

This association makes up about 29 percent of the county. It is about 34 percent Keswick soils, 32 percent Lindley soils, 29 percent Gorin soils, and 5 percent minor soils (fig. 3).

Keswick soils are strongly sloping and moderately well drained. They are on side slopes. Typically, they have a surface layer of dark brown clay loam. The upper part of the subsoil is dark brown and strong brown clay, the next part is yellowish brown clay, and the lower part is mottled strong brown and gray clay loam. The substratum is yellowish brown clay loam.

Lindley soils are moderately steep and steep and are moderately well drained. They are on side slopes. Typically, they have a surface layer of very dark grayish brown loam. The subsurface layer is dark grayish brown loam. The subsoil is clay loam. It is yellowish brown and strong brown in the upper part and yellowish brown and mottled in the lower part. The substratum is multicolored clay loam.

Gorin soils are moderately sloping and somewhat poorly drained. They are on side slopes and ridgetops. Typically, they have a surface layer of very dark grayish brown silt loam. The subsurface layer is brown silt loam. The subsoil is dark yellowish brown silty clay loam in the upper part and dark yellowish brown, grayish brown, and yellowish brown, mottled silty clay, silty clay loam, and clay loam in the lower part.

Minor in this association are the moderately deep Vanmeter soils. These soils are in landscape positions similar to those of the Lindley soils.

About 65 percent of this association supports hardwoods, dominantly oak and hickory. The cleared areas, which are mainly on ridgetops and some of the upper side slopes, are used for pasture.

The forested acreage consists of areas that are too steep to be cleared. The slope in the steep areas restricts the use of logging equipment.

The less sloping areas, most of which are cleared, are suitable for pasture. Some of the cleared areas are suitable for cultivated crops. The slope and the hazard of water erosion are the main concerns in managing pasture.

The major soils are suitable for some sanitary facilities and for building site development. Slow permeability, the slope, and a moderate shrink-swell potential in the clayey subsoil are the main limitations.

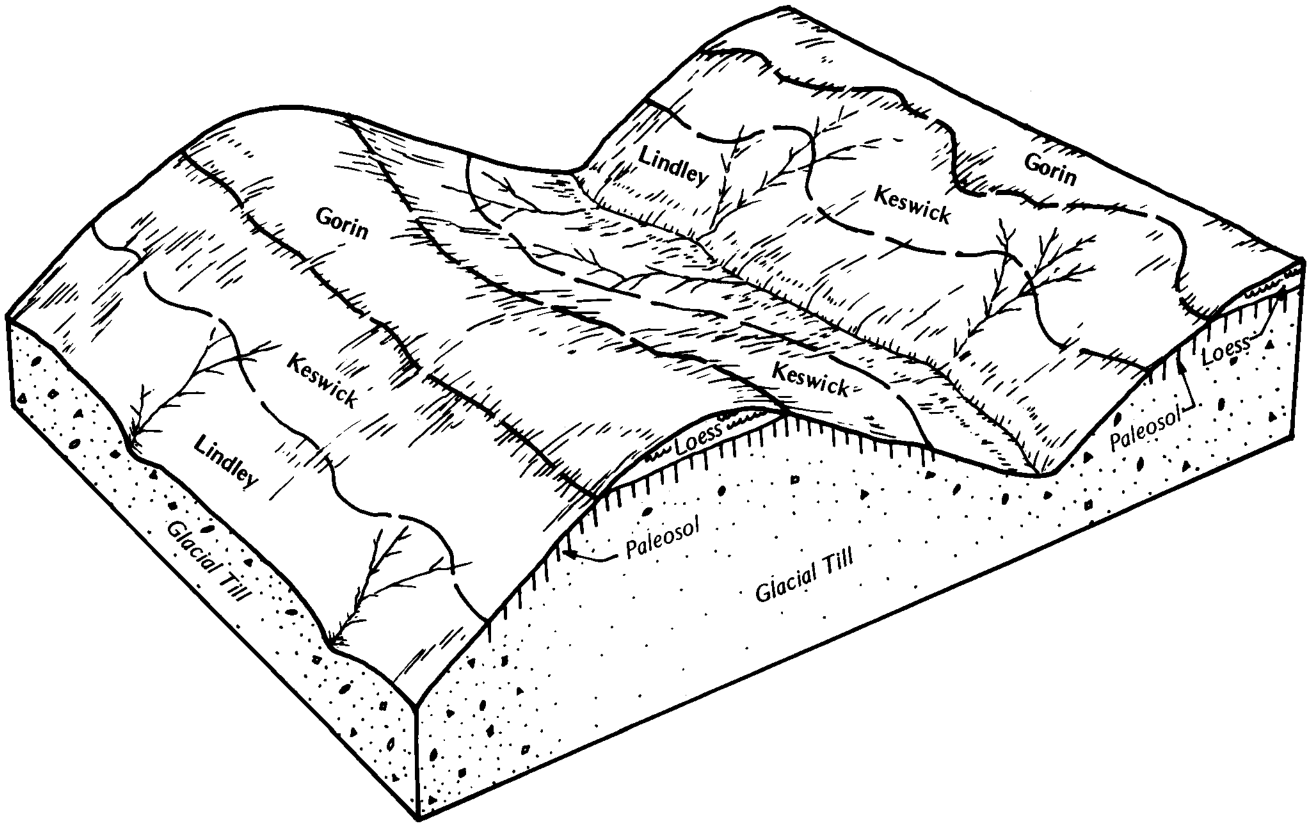

Figure 3.—Typical pattern of soils and parent material in the Keswick-Lindley-Gorin association.

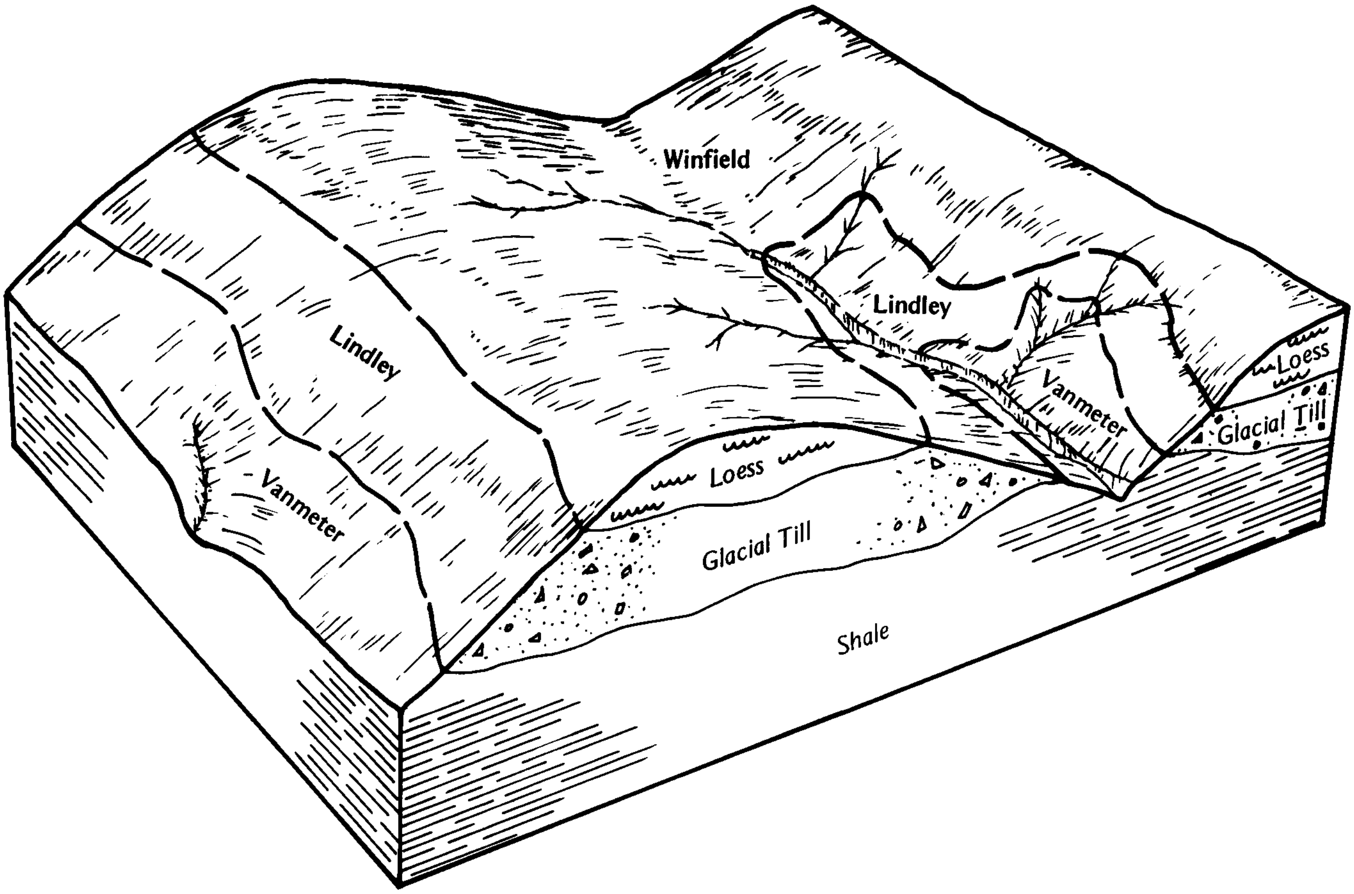

Figure 4.—Typical pattern of soils and parent material in the Winfield-Lindley-Vanmeter association.

4. Winfield-Lindley-Vanmeter Association

Moderately sloping to steep, moderately well drained soils formed in loess, in glacial till, and in shale residuum; on uplands

This association is in deeply dissected areas adjacent to the flood plain along the Mississippi River and in some areas adjacent to the flood plains along the Fabius and Wyaconda Rivers. Slopes range from 5 to 35 percent.

This association makes up about 14 percent of the county. It is about 48 percent Winfield soils, 26 percent Lindley soils, 20 percent Vanmeter soils, and 6 percent minor soils (fig. 4).

Winfield soils are moderately sloping to steep and are on narrow ridges and side slopes. Typically, they have a surface layer of dark grayish brown silt loam. The subsoil is silty clay loam. The upper part is dark brown and dark yellowish brown, and the lower part is light brownish gray and mottled. The substratum is light brownish gray, mottled silt loam.

Lindley soils are moderately steep and steep and are on side slopes. Typically, they have a surface layer of very dark grayish brown loam. The subsurface layer is dark grayish brown loam. The subsoil is clay loam. It is yellowish brown and strong brown in the upper part and yellowish brown and mottled in the lower part. The substratum is multicolored clay loam.

Vanmeter soils are moderately steep and steep and are on side slopes. Typically, they have a surface layer of dark grayish brown silt loam. The subsoil is dark brown silty clay loam and silty clay in the upper part and dark yellowish brown silty clay in the lower part. Olive yellow, weathered shale bedrock is at a depth of about 32 inches.

Minor in this association are the well drained Menfro and moderately well drained Weller soils on ridgetops. Weller soils have more clay than the Lindley and Winfield soils.

About half of the acreage in this association is used for corn, soybeans, small grain, or hay. The other half either has been cleared and is used for pasture or consists of steep, uneven areas that support mixed hardwoods.

The main concerns in managing this association for crops are controlling water erosion and improving or maintaining fertility and tilth. The hazard of water erosion caused by overgrazing is the main concern in managing pasture.

The major soils are well suited to trees. The Winfield soils are well suited to orchards. The wooded areas dominantly support oak and hickory. Timber stand improvement is needed in these areas.

The major soils are suitable for some sanitary facilities and for building site development. The major limitations are the slope and a moderate shrink-swell potential in the subsoil.

5. Westerville-Chequest-Darwin Association

Nearly level, somewhat poorly drained to very poorly drained soils formed in silty and clayey alluvium; on flood plains

This association is on the flood plain along the Mississippi River. Elevation differences are slight. In general, the lower areas are along the river channel and the elevation increases gradually toward the surrounding uplands. Slopes range from 0 to 2 percent.

This association makes up about 8 percent of the county. It is about 35 percent Westerville soils, 19 percent Chequest soils, 17 percent Darwin soils, and 29 percent minor soils.

Westerville soils are somewhat poorly drained. They are in the slightly higher areas away from the river. Typically, they have a surface layer of dark grayish brown silt loam. Below this is a transitional layer of grayish brown, mottled silt loam. The substratum is dark grayish brown and grayish brown, mottled silty clay loam in the upper part and gray and dark grayish brown, mottled silty clay loam and silt loam in the lower part.

Chequest soils are poorly drained. They generally are in areas between the Westerville and Darwin soils. Typically, they have a surface layer and subsurface layer of very dark gray silty clay loam. The subsoil is dark gray and gray, mottled silty clay loam in the upper part and dark gray, mottled silty clay in the lower part.

Darwin soils are very poorly drained. They are in

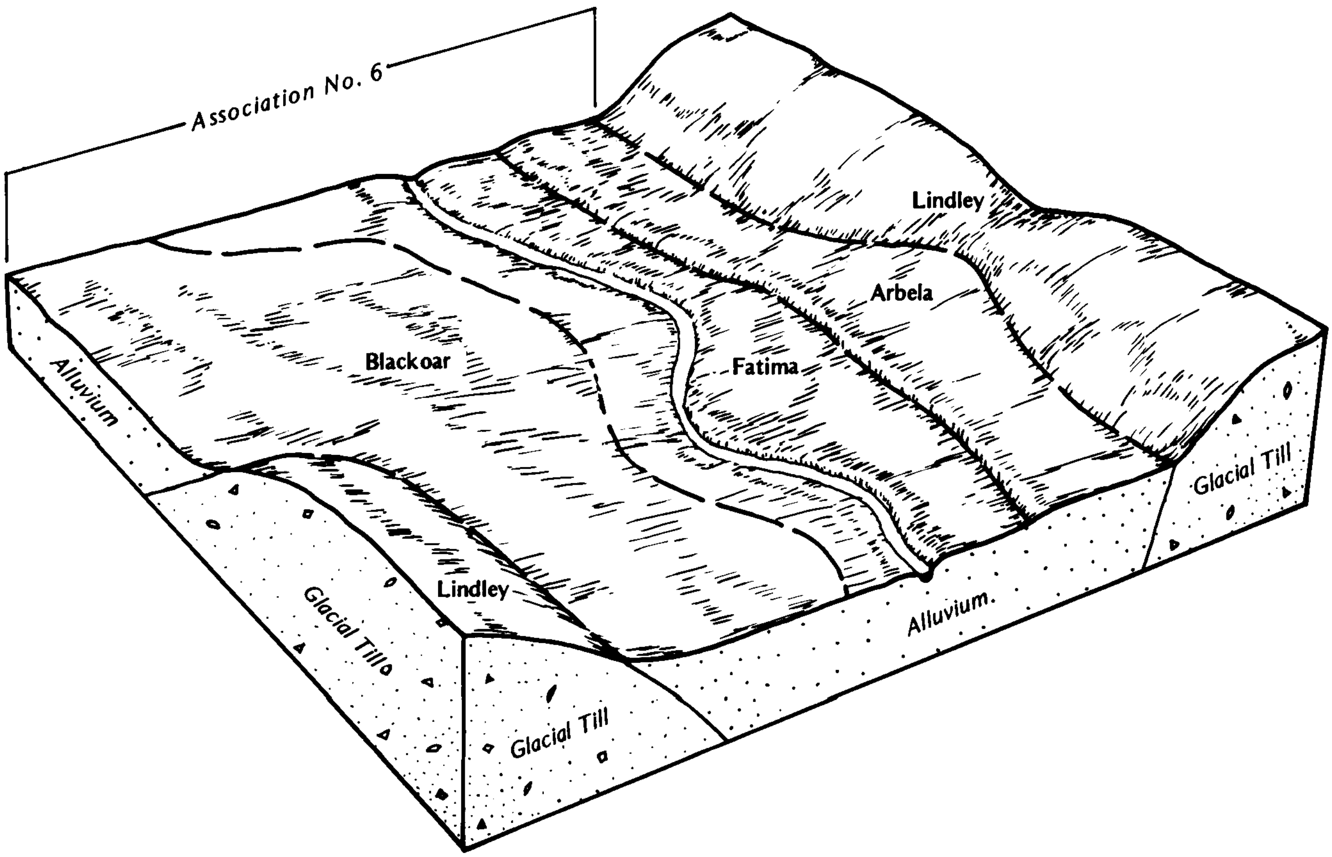

Figure 5.—Typical pattern of soils and parent material in the Blackoar-Fatima-Arbela association.

slightly depressional, broad areas near the river. Typically, they have a surface layer of very dark gray silty clay. The subsoil and substratum are dark gray, mottled silty clay.

Minor in this association are the moderately well drained Fatima soils, the well drained Jasper and Kickapoo soils, and the excessively drained Udipsamments. Fatima and Kickapoo soils are at the slightly higher elevations nearest the streams. Jasper soils are on elongated ridges at higher elevations than the flood plain. Udipsamments are in mounded, irregularly shaped areas that are separated by areas of water.

Most of the acreage in this association is used for cultivated crops, commonly corn and soybeans. Most of the association is leveed. Wetness is the main concern in managing cropland.

The major soils are suitable for trees, although very few areas are wooded. The stands of trees generally are in depressional spots. Cottonwood, black willow, and silver maple are the dominant species.

The major soils generally are unsuitable for sanitary facilities and building site development. Wetness, flooding, and a high content of clay are the main limitations.

6. Blackoar-Fatima-Arbela Association

Nearly level, poorly drained and moderately well drained soils formed in silty alluvium; on flood plains

This association is on flood plains along small rivers and streams. The flood plains commonly are 1 mile or less wide. Slopes range from 0 to 2 percent.

This association makes up about 14 percent of the county. It is about 28 percent Blackoar and similar soils, 25 percent Fatima and similar soils, 24 percent Arbela and similar soils, and 23 percent minor soils (fig. 5).

Blackoar soils are poorly drained. They commonly are in slightly depressional areas. Typically, they have a surface layer and subsurface layer of very dark grayish brown silt loam. The subsoil is dark gray, mottled silt loam. The substratum is gray, mottled silt loam.

Fatima soils are moderately well drained. They are slightly higher on the landsacape than the Blackoar soils. Typically, they have a surface layer and subsurface layer of very dark grayish brown silt loam. The subsoil is dark grayish brown and grayish brown, mottled silt loam. The substratum is grayish brown, mottled silt loam.

Arbela soils are poorly drained. They are slightly higher on the landscape than the Fatima soils, generally in the areas farthest from the streams. Typically, they have a surface layer of very dark grayish brown silt loam. The subsurface layer is grayish brown silt loam. The subsoil is dark grayish brown and dark gray, mottled silty clay loam.

Minor in this association are Gifford and Vigar soils. The poorly drained, moderately sloping Gifford soils are on the side slopes of stream terraces. The moderately well drained, gently sloping Vigar soils are on foot slopes in the uplands.

Nearly all of this association is used for corn, soybeans, or wheat. Some very small areas remain wooded. Flooding and wetness are the main concerns in managing cropland.

The major soils are suitable for trees, although few areas are wooded. The stands generally are close to the streams or are around old meanders. Cottonwood, black willow, and silver maple are the dominant species.

The major soils generally are unsuitable for sanitary facilities and building site development. Flooding and wetness are the major limitations.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can help to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Winfield silt loam, 5 to 9 percent slopes, eroded, is a phase of the Winfield series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

The descriptions, names, and delineations of the soils on the detailed soil maps of this county do not fully agree with those on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping the soils separately and giving them different names.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

1—Arbela silt loam. This nearly level, poorly drained soil is in high areas on flood plains. It is occasionally flooded for brief periods. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 13 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 9 inches thick. The subsoil to a depth of 60 inches or more is dark grayish brown and dark gray, mottled, firm silty clay loam.

Included with this soil in mapping are areas of Moniteau soils, the somewhat poorly drained Westerville soils, and the moderately well drained Vigar soils. Moniteau soils have less clay in the subsoil than the Arbela soil. They are in positions on flood plains similar to those of the Arbela soil. Westerville soils are in the slightly lower landscape positions, and Vigar soils are in the higher positions at the base of steep slopes. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Arbela soil. Surface runoff is slow. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderate. The shrink-swell potential also is moderate. The seasonal high water table is within a depth of 1.5 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The wetness and the flooding are the main problems. Flooding delays planting and interferes with harvesting during some years. Also, it damages crops during some years. The wetness can be reduced by shallow surface ditches and by land grading. In areas adjacent to uplands, diversions can be constructed to provide protection against runoff from the uplands. Returning crop residue to the soil can help to maintain fertility and tilth.

This soil is suited to pasture but is poorly suited to hay. It is best suited to water-tolerant, shallow-rooted species. It is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil, ladino clover, and redtop. The wetness and the flooding are the main problems. The periods of flooding should be considered when grazing systems are designed. A seedbed can be easily prepared only during dry periods. A surface drainage system can improve the growing conditions for the deeper rooted species.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. No woodland ordination symbol is assigned.

2—Chariton silt loam. This nearly level, poorly drained soil is on high stream terraces along the major streams. The terraces are 5 to 20 feet higher than the adjacent flood plains. Individual areas are irregular in shape and range from about 25 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 8 inches thick. The subsoil is mottled silty clay about 34 inches thick. The upper part is dark gray and firm, the next part is dark grayish brown and very firm, and the lower part is grayish brown and firm. The substratum to a depth of 60 inches or more is mottled gray and yellowish brown, firm clay loam.

Included with this soil in mapping are small areas of the gently sloping and moderately sloping Gifford soils. These soils are on the lower side slopes. They make up about 10 percent of the unit.

Permeability is slow in the Chariton soil. Surface runoff also is slow. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderately low. The shrink-swell potential is high. A perched water table is within a depth of 1.5 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The wetness is the main problem. Diversions constructed at the base of the adjacent upland slopes help to keep excess water from moving onto this soil. Shallow surface ditches help to remove excess water.

This soil is suited to pasture but is poorly suited to hay. It is best suited to water-tolerant, shallow-rooted species. It is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil, ladino clover, and redtop. The wetness is the main problem. A surface drainage system can improve the growing conditions for the deeper rooted species.

This soil is suited to building site development and some kinds of onsite waste disposal. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Constructing the buildings on raised, well compacted fill material and installing drainage tile around the footings help to prevent the damage caused by excessive wetness. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can minimize the damage caused by shrinking and swelling and by frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the slow permeability. Properly designed sewage lagoons can function adequately.

Low strength, the high shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Building the roads on raised, well compacted fill material and installing a drainage system that includes roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

3—Blackoar silt loam. This nearly level, poorly drained soil is on flood plains along small and large streams. It is occasionally flooded for brief periods. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer also is very dark grayish brown, friable silt loam. It is about 5 inches thick. The subsoil is dark gray, mottled, friable silt loam about 22 inches thick. The substratum to a depth of 60 inches or more is gray, mottled, friable silt loam. In some areas the surface layer is dark grayish brown.

Included with this soil in mapping are areas of Chequest soils, the somewhat poorly drained Westerville soils, and the moderately well drained

Fatima soils. Chequest soils are more clayey throughout than the Blackoar soil. They are in landscape positions similar to those of the Blackoar soil. Westerville soils are in the slightly higher landscape positions. Fatima soils generally are closer to stream channels than the Blackoar soil. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Blackoar soil. Surface runoff is slow. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderate. The seasonal high water table is within a depth of 1 foot during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and grain sorghum. The occasional flooding and the wetness are the main problems. Flooding delays planting and interferes with harvesting during some years. Also, it damages crops during some years. The wetness can be reduced by shallow surface ditches and by land grading. Returning crop residue to the soil can help to maintain fertility and tilth.

This soil is suited to pasture, but it is poorly suited to hay because of the flooding. It is best suited to water-tolerant, shallow-rooted species. It is moderately suited to alsike clover and reed canarygrass. The periods of flooding should be considered when grazing systems are designed. The texture of the surface layer allows for easy seedbed preparation. A surface drainage system can improve the growing conditions for the deeper rooted species.

This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. The trees should be harvested and planted when the soil is dry or frozen. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 4W.

4—Darwin silty clay. This nearly level, very poorly drained soil is in the lower areas on the flood plain along the Mississippi River. It is subject to ponding. It is protected by levees but can be occasionally flooded for brief periods because of the possibility of a levee break and because of runoff from the adjacent areas. Individual areas are irregular in shape and range from about 100 to several hundred acres in size.

Typically, the surface layer is very dark gray, firm silty clay about 12 inches thick. The subsoil is dark gray, mottled, firm silty clay about 30 inches thick. The substratum to a depth of 60 inches or more is dark gray, mottled, firm silty clay. In some areas the lower part of the subsoil is silty clay loam. In other areas the dark surface soil is more than 24 inches thick.

Included with this soil in mapping are areas of the poorly drained Chequest soils. These soils are less clayey than the Darwin soil. They are in landscape positions similar to those of the Darwin soil. Also included are small areas of frequently flooded Darwin soils between the Mississippi River and the levees. Included soils make up about 5 to 10 percent of the unit.

Permeability is very slow in the Darwin soil. Surface runoff also is very slow. The available water capacity is moderate. Natural fertility and the content of organic matter are high. The shrink-swell potential is very high. The seasonal high water table is above the surface or within a depth of 2 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The wetness is the main problem. It delays planting and interferes with harvesting during most years. Surface drainage can be improved by shallow surface ditches. Wet spots can be filled by land grading. Deep tillage in the fall improves tilth and allows for earlier seeding in the spring. Crop damage can be expected in some years because of the flooding.

This soil is suited to pasture but is poorly suited to hay. It is best suited to water-tolerant, shallow-rooted species. It is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil, ladino clover, and redtop. The wetness and the flooding are the main problems. Maintaining stands of desirable species is difficult in depressions. The periods of flooding should be considered when grazing systems are designed. Seedbed preparation is difficult because of the clayey surface layer.

This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. The trees should be harvested and planted when the soil is dry or frozen. Planting container-grown nursery stock and ridging the soil and then planting on the ridges increase the seedling survival rate. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

5—Fatima silt loam. This nearly level, moderately well drained soil generally is on flood plains along minor streams but also is on flood plains along some of the major streams. It is occasionally flooded for brief periods. Individual areas are irregular in shape and range from about 20 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is very dark grayish brown, mottled, friable silt loam about 9 inches thick. The subsoil is mottled, friable silt loam about 27 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of 60 inches or more is grayish brown, mottled, friable silt loam.

Included with this soil in mapping are areas of the poorly drained Blackoar and well drained Kickapoo soils. Blackoar soils are in slightly depressional areas. Kickapoo soils are closer to stream channels than the Fatima soil. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Fatima soil. Surface runoff is medium. The available water capacity is very high. Natural fertility is high, and the content of organic matter is moderate. The seasonal high water table is at a depth of 3 to 5 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Crop damage can be expected during some years because of the flooding.

This soil is suited to pasture. It is well suited to ladino clover, red clover, orchardgrass, tall fescue, and switchgrass. It is moderately well suited to big bluestem, indiangrass, and little bluestem. Flooding is a hazard, but it is usually of brief duration. The texture of the surface layer allows for easy seedbed preparation. A surface drainage system can improve the growing conditions for the deeper rooted species.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil generally is unsuitable for building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 5A.

6—Kickapoo fine sandy loam. This nearly level, well drained soil is on flood plains along major and minor streams. It is frequently flooded for brief periods. Individual areas are irregular in shape and range from about 10 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 5 inches thick. The upper substratum is about 21 inches of stratified brown, dark grayish brown, dark yellowish brown, and dark brown, friable sandy loam and fine sandy loam. Next is a buried surface layer of very dark grayish brown, friable silt loam about 9 inches thick. The lower substratum to a depth of 60 inches or more is dark brown and brown, friable fine sandy loam and silt loam.

Included with this soil in mapping are areas of Fatima and Vigar soils and areas of the somewhat poorly drained Westerville soils. Fatima and Vigar soils are less sandy than the Kickapoo soil. Included soils are farther from stream channels than the Kickapoo soil. They make up about 10 percent of the unit.

Permeability is moderate in the Kickapoo soil. Surface runoff is slow. The available water capacity is high. Natural fertility is low, and the content of organic matter is moderate.

Because of the flooding, this soil is generally not used for cultivated crops. It is suited to pasture. It is well suited to ladino clover, tall fescue, and bermudagrass. It is moderately well suited to red clover, big bluestem, and indiangrass and is moderately suited to alfalfa. The frequent flooding is a hazard, but it is usually of brief duration. The species that can withstand flooding should be selected for planting. Droughtiness is a problem. The texture of the surface layer allows for easy seedbed preparation.

Some areas have small stands of native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 3W.

7C2—Gifford silt loam, 3 to 9 percent slopes, eroded. This gently sloping and moderately sloping, poorly drained soil is on the side slopes of stream terraces. It is subject to rare flooding. Water erosion has removed some of the original surface layer. It has caused the formation of shallow gullies in places. Individual areas are narrow and irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The subsoil is about 27 inches thick. It is mottled and firm. The upper part is brown silty clay loam, and the lower part is dark grayish brown and grayish brown silty clay. The substratum to a depth of 60 inches or more is mottled gray and yellowish brown, firm clay loam.

Included with this soil in mapping are areas of the nearly level Chariton soils. These soils are in the slightly higher landscape positions. They make up about 5 to 10 percent of the unit.

Permeability is very slow in the Gifford soil. Surface runoff is medium. The available water capacity is high. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is high. A perched water table is at a depth of 0.5 foot to 2.0 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Further water erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, contour farming, stripcropping, and grassed waterways help to prevent excessive soil loss. Proper management of crop residue and green manure crops can help to control water erosion, maintain or increase the content of organic matter, maintain or improve tilth, and increase the rate of water infiltration. The wetness sometimes delays fieldwork in the spring.

This soil is suited to pasture. It is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil, ladino clover, and redtop. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

If protected from flooding, this soil is suited to building site development and some kinds of onsite waste disposal. Buildings should be constructed above known flood levels or on raised, well compacted fill material. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can help to prevent the damage caused by shrinking and swelling and by frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the very slow permeability. Properly designed sewage lagoons can function adequately. Leveling of the lagoon site is necessary.

Low strength, the high shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

8B—Vigar loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on foot slopes in the uplands. It is subject to rare flooding. Individual areas are elongated and irregular in shape and range from about 10 to 25 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable loam about 18 inches thick. The subsoil to a depth of 60 inches or more is mottled, firm clay loam. The upper part is dark brown, the next part is dark grayish brown and dark brown, and the lower part is brown. In some areas the dark surface soil is less than 10 inches thick.

Included with this soil in mapping are small areas of the poorly drained Arbela and well drained Kickapoo soils and the moderately steep and steep Lindley soils. Arbela and Kickapoo soils are on flood plains. Lindley soils are in the higher positions on uplands. Their light colored surface layer is thinner than that of the Vigar soil. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Vigar soil. Surface runoff is medium. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderate. The shrink-swell potential also is moderate. The seasonal high water table is at a depth of 2 to 3 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Water erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year and winter cover crops help to control water erosion. Most areas are too small or narrow to be managed separately but can be terraced and farmed on the contour along with the adjacent soils. Diversions can protect areas that receive runoff from the adjacent uplands.

This soil is suited to pasture and hay. It is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, and switchgrass and is moderately suited to alfalfa and little bluestem. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding and the wetness.

The land capability classification is IIe. No woodland ordination symbol is assigned.

9—Westerville silt loam. This nearly level, somewhat poorly drained soil is on flood plains along creeks and rivers. It is occasionally flooded for brief periods. Individual areas are irregular in shape and range from about 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 9 inches thick. Below this is a transitional layer of grayish brown, mottled, very friable silt loam about 10 inches thick. The substratum extends to a depth of 60 inches or more. It is mottled. It is dark grayish brown and grayish brown, firm silty clay loam in the upper part and gray and dark grayish brown, firm silty clay loam and silt loam in the lower part.

Included with this soil in mapping are areas of the poorly drained Chequest, Blackoar, and Moniteau soils and the moderately well drained Kickapoo soils. Also included are areas of Arbela soils, which are more clayey than the Westerville soil. Moniteau and Arbela soils are on the slightly higher flood plains. Chequest, Blackoar, and Kickapoo soils are on the slightly lower flood plains. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Westerville soil. Surface runoff is slow. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderately low. The seasonal high water table is at a depth of 1 to 3 feet during most winter and spring months.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. The wetness is the main problem. Diversions constructed at the base of the adjacent upland slopes help to keep excess water from moving onto this soil. Shallow surface ditches help to remove excess water. Returning crop residue to the soil can help to maintain fertility and tilth.

This soil is suited to pasture. It is well suited to reed canarygrass. It is moderately well suited to ladino clover, red clover, tall fescue, and switchgrass and is moderately suited to big bluestem, indiangrass, and little bluestem. The wetness is the main problem. Flooding is a hazard, but it usually is of brief duration. The texture of the surface layer allows for easy seedbed preparation. A surface drainage system can improve the growing conditions for the deeper rooted species.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 5A.

10C2—Leonard silty clay loam, 5 to 9 percent slopes, eroded. This moderately sloping, poorly drained soil is on convex ridgetops and at the head of drainageways in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. Individual areas are irregular in shape and range from about 20 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil to a depth of 60 inches or more is mottled, firm and very firm silty clay. The upper part is dark grayish brown, the next part is gray, and the lower part is grayish brown and light olive gray. In some areas the subsoil is redder. In other areas the lower part of the subsoil does not have glacial sand or pebbles.

Included with this soil in mapping are small areas of the moderately well drained Armstrong soils on the lower side slopes. Also included are severely eroded areas where the surface layer is dark grayish brown silty clay. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Leonard soil. Surface runoff is medium. The available water capacity is moderate. Natural fertility is medium, and the content of organic matter is moderate. The shrink-swell potential is high. A perched water table is at a depth of 0.5 foot to 2.0 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Further water erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, contour farming, stripcropping, and terraces that have suitable outlets help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. The wetness sometimes delays fieldwork in the spring.

This soil is suited to pasture. It is best suited to water-tolerant, shallow-rooted species. It is moderately well suited to reed canarygrass and switchgrass and is moderately suited to birdsfoot trefoil, tall fescue, bermudagrass, and indiangrass. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. The pasture should be tilled on the contour. Rotation grazing is needed to prevent overgrazing.

This soil is suited to building site development and some kinds of onsite waste disposal. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can help to prevent the damage caused by shrinking and swelling and by frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the slow permeability. Properly designed sewage lagoons can function adequately. Leveling of the lagoon site is necessary.

Low strength, the high shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

11C2—Armstrong loam, 5 to 9 percent slopes, eroded. This moderately sloping, moderately well drained soil is on convex ridgetops and side slopes in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. Individual areas are irregular in shape and range from about 10 to 40 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loam about 6 inches thick. The subsoil about 48 inches thick. It is mottled. The upper part is brown and dark brown, friable and firm clay loam; the next part is strong brown, very firm clay; and the lower part is yellowish brown, grayish brown, and strong brown, very firm and firm clay loam. The substratum to a depth of 60 inches or more is yellowish brown, mottled, very firm clay loam.

Included with this soil in mapping are small areas of the poorly drained Leonard and Kilwinning soils. These soils are in the higher landscape positions. Also included are severely eroded areas where the surface layer is dark brown. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Armstrong soil. Surface runoff is medium. The available water capacity is moderate. Natural fertility is medium, and the content of organic matter is moderate. The shrink-swell potential is high. A perched water table is at a depth of 1 to 3 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Further water erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, contour farming, stripcropping, and terraces that have suitable outlets help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling water erosion (fig. 6). This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, and switchgrass and is moderately suited to alfalfa and little bluestem. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil is suited to building site development and some kinds of onsite waste disposal. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can minimize the damage caused by shrinking and swelling and by frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the slow permeability and

Figure 6.—Hay in an area of Armstrong loam, 5 to 9 percent slopes, eroded. A cover of grasses and legumes is effective in controlling erosion on this soil.

the wetness. Properly designed sewage lagoons can function adequately. Leveling of the lagoon site is necessary.

Low strength, the high shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

12C—Gorin silt loam, 5 to 9 percent slopes. This moderately sloping, somewhat poorly drained soil is on convex ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 3 inches thick. The subsurface layer is brown, very friable silt loam about 3 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is dark yellowish brown, firm silty clay loam; the next part is dark yellowish brown, mottled, very firm silty clay; and the lower part is grayish brown, yellowish brown, and dark yellowish brown, mottled, firm silty clay loam and clay loam. In some areas the dark surface layer is 7 or more inches thick.

Included with this soil in mapping are areas of the poorly drained Kilwinning soils in the higher landscape positions and the moderately well drained Armstrong and Lindley soils on the lower, steeper side slopes. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Gorin soil. Surface runoff is medium. The available water capacity is high. Natural fertility and the content of organic matter are low. The shrink-swell potential is high. A perched water table is at a depth of 2 to 4 feet during most winter and spring months.

Most areas are used as woodland or pasture. This soil is suited to corn, soybeans, and small grain if water erosion is controlled. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, and grassed waterways help to prevent excessive soil loss. Some areas are smooth enough and large enough to be terraced and farmed on the contour. Proper management of crop residue and green manure crops can help to control water erosion, maintain or increase the content of organic matter, maintain or improve tilth, and increase the rate of water infiltration.

This soil is well suited to ladino clover for pasture or hay. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, and switchgrass and is moderately suited to alfalfa and little bluestem. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive water erosion.

Some areas support native hardwoods. This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil is suited to building site development and some kinds of onsite waste disposal. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can minimize the damage caused by shrinking and swelling and by frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the slow permeability and the wetness. Properly designed sewage lagoons can function adequately. Leveling of the lagoon site is necessary.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3C.

13E—Lindley loam, 14 to 20 percent slopes. This moderately steep, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 200 acres in size.

Typically, the surface layer is very dark gray, friable loam about 3 inches thick. The subsurface layer is grayish brown, friable loam about 2 inches thick. The subsoil is yellowish brown, mottled, very firm clay loam about 27 inches thick. The substratum to a depth of 60 inches or more is yellowish brown, mottled, very firm clay loam. In some areas the dark surface layer is thicker.

Included with this soil in mapping are areas of Armstrong, Vanmeter, Vigar, and Gorin soils. Armstrong and Gorin soils are on the higher, lesser sloping ridgetops and side slopes. Armstrong soils have more clay in the subsoil than the Lindley soil and have a thicker dark surface layer. Gorin soils are somewhat poorly drained. Vanmeter soils are moderately deep. They are on the short, steeper, lower slopes. Vigar soils have a thick, dark surface layer. They are in the lower positions at the base of the slopes. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is low, and the content of organic matter is moderately low. The shrink-swell potential is moderate. The seasonal high water table is at a depth of 2.0 to 3.5 feet during most winter and spring months.

Most areas are used as pasture or woodland. This soil is too steep for cultivation and should only be tilled when reseeding of grasses and legumes is necessary. It is well suited to birdsfoot trefoil, red clover, tall fescue, timothy, and switchgrass. It is moderately well suited to alfalfa, alsike clover, orchardgrass, big bluestem, and indiangrass. Water erosion during seedbed preparation is a problem. The pasture should be tilled on the contour, and nurse crops or crop residue should be left on the surface. Overgrazing should be avoided. Measures that maintain fertility and control brush are needed.

Some areas support large stands of native hardwoods. This soil is suited to trees. The hazard of water erosion and the equipment limitation are management concerns. Logging roads and skid trails should be established on the contour because of the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after the trees are harvested. In the steepest areas it may be necessary to yard the logs uphill to the logging roads or skid trails.

This soil generally is unsuited to building site development and onsite waste disposal because the slope is a severe limitation. This limitation is severe mainly because of the difficulty and extra cost of designing and preparing the site for construction.

The land capability classification is VIe. The woodland ordination symbol is 3R.

13F—Lindley loam, 20 to 35 percent slopes. This steep, moderately well drained soil is on convex side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loam about 3 inches thick. The subsurface layer is dark grayish brown, very friable loam about 4 inches thick. The subsoil is clay loam about 39 inches thick. The upper part is yellowish brown and strong brown and is firm, and the lower part is yellowish brown, mottled, and very firm. The substratum to a depth of 60 inches or more is multicolored, very firm clay loam. In some areas the dark surface layer is thicker.

Included with this soil in mapping are areas of Armstrong, Winfield, Vanmeter, Vigar, and Gorin soils. Armstrong, Winfield, and Gorin soils are on the higher, less sloping ridgetops and side slopes. Armstrong soils have more clay in the subsoil than the Lindley soil and have a thicker dark surface layer. Gorin soils are somewhat poorly drained. Winfield soils do not have glacial sand and pebbles. Vanmeter soils are moderately deep. They are on the short, steeper, lower slopes. Vigar soils have a thick, dark surface layer. They are in the lower positions at the base of the slopes. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Lindley soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is low, and the content of organic matter is moderately low. The shrink-swell potential is moderate. The seasonal high water table is at a depth of 2.0 to 3.5 feet during most winter and spring months.

Most areas are wooded. This soil is suited to trees. The hazard of water erosion and the equipment limitation are management concerns. Logging roads and skid trails should be established on the contour because of the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after the trees are harvested. In the steepest areas it may be necessary to yard the logs uphill to the logging roads or skid trails.

In cleared areas pasture grasses can be seeded. Growing grasses and lagumes for pasture is effective in controlling water erosion. This soil is well suited to birdsfoot trefoil, red clover, tall fescue, timothy, and switchgrass. It is moderately well suited to alfalfa, alsike clover, orchardgrass, big bluestem, and indiangrass. The slope is a limitation when the pasture is seeded. The pasture should be tilled on the contour, and nurse crops or crop residue should be left on the surface. Overgrazing should be avoided. Measures that maintain fertility and control brush are needed.

This soil generally is unsuited to building site development and onsite waste disposal because the slope is a severe limitation. This limitation is severe mainly because of the difficulty and extra cost of designing and preparing the site for construction.

The land capability classification is VIIe. The woodland ordination symbol is 3R.

14—Chequest silty clay loam. This nearly level, poorly drained soil is on flood plains. It is in the lower areas away from the natural stream channels. It is protected by levees but can be occasionally flooded for brief periods because of the possibility of a levee break and because of runoff from the adjacent areas. Individual areas are irregular in shape and range from about 20 to 300 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 7 inches thick. The subsurface layer is very dark gray, firm silty clay loam about 10 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled and firm. The upper part is dark gray and gray silty clay loam, and the lower part is dark gray silty clay.

Included with this soil in mapping are areas of Darwin soils and the somewhat poorly drained Westerville soils. These soils are on the flood plain along the Mississippi River. Darwin soils are in slightly depressional areas. They are more clayey than the Chequest soil. Westerville soils are in the slightly higher landscape positions. Also included are some areas of Blackoar soils. These soils are mainly on flood plains along the smaller tributaries. They are more silty than the Chequest soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Chequest soil. Surface runoff is slow. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderate. The shrink-swell potential is high. The seasonal high water table is at a depth of 1 to 3 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The wetness is the main problem. Surface drainage can be improved by land grading and by shallow surface ditches. Crop damage can be expected during some years because of the flooding.

This soil is suited to pasture but is poorly suited to hay. It is best suited to water-tolerant, shallow-rooted species. It is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil, ladino clover, and redtop. The wetness and the flooding are the main problems. The periods of flooding should be considered when grazing systems are designed. A seedbed can be easily prepared only during dry periods. A surface drainage system can improve the growing conditions for the deeper rooted species.

This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. The trees should be harvested and planted when the soil is dry or frozen. Planting container-grown nursery stock and ridging the soil and then planting on the ridges increase the seedling survival rate. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 7W.

15B—Kilwinning silt loam, 2 to 5 percent slopes. This gently sloping, poorly drained soil is on the upper side slopes and narrow ridgetops in the uplands. Individual areas are irregular in shape and range from about 15 to 320 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled. The upper part is dark gray, firm silty clay; the next part is dark grayish brown, firm and very firm silty clay; and the lower part is gray, firm silty clay loam. In some areas the dark surface layer is thinner.

Included with this soil in mapping are areas of Putnam, Gorin, and Armstrong soils. Putnam soils are nearly level and are in broad areas on uplands. They are characterized by an abrupt textural change between the surface soil and the subsoil. Armstrong soils are moderately well drained and are on the lower side slopes. Gorin soils are somewhat poorly drained and are on the lower, more sloping ridges. Included soils make up about 5 to 10 percent of the unit.

Permeability is very slow in the Kilwinning soil. Surface runoff is medium. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderate. The shrink-swell potential is high. A perched water table is at a depth of 1 to 2 feet during most winter and spring months.

Most areas are used for cultivated crops (fig. 7). This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, contour farming, and terraces that have suitable outlets help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration. The wetness sometimes delays fieldwork in the spring.

This soil is suited to pasture. It is best suited to water-tolerant, shallow-rooted species. It is moderately well suited to birdsfoot trefoil, reed canarygrass, and switchgrass and is moderately suited to tall fescue, big bluestem, and indiangrass. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to building site development and some kinds of onsite waste disposal. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can help to prevent the damage caused by shrinking and swelling and by frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the very slow permeability. Properly designed sewage lagoons can function adequately. Leveling of the lagoon site may be necessary.

Low strength, the high shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

18—Putnam silt loam. This nearly level, poorly drained soil is on broad flats in the uplands. Individual

Figure 7.—Drilled soybeans in an area of Kilwinning silt loam, 2 to 5 percent slopes.

areas are irregular in shape and range from about 10 to 600 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 8 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled. The upper part is dark grayish brown and grayish brown, very firm silty clay, and the lower part is light brownish gray, firm silty clay loam.

Permeability is very slow in the Putnam soil. Surface runoff is slow. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderate. The shrink-swell potential is high. A perched water table is at a depth of 0.5 foot to 1.5 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The slow runoff rate and the wetness are problems after heavy rains. The wetness sometimes delays fieldwork in the spring. Surface drainage can be improved by land grading and by shallow surface ditches. Improving or maintaining fertility is a management concern. Applications of lime and fertilizer should be based on the results of a soil test. Proper management of crop residue and green manure crops help to maintain or increase the content of organic matter, maintain or improve tilth, and increase the rate of water infiltration.

This soil is suited to pasture. It is best suited to water-tolerant, shallow-rooted species. It is moderately well suited to birdsfoot trefoil, reed canarygrass, and switchgrass and is moderately suited to tall fescue, big bluestem, and indiangrass. The wetness is the main problem. A seedbed can be easily prepared during wet periods. These periods should be considered when grazing systems are designed.

This soil is suited to building site development and some kinds of onsite waste disposal. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Constructing the buildings on raised, well compacted fill material and installing drainage tile around the footings help to prevent the damage caused by excessive wetness. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can minimize the damage caused by shrinking and swelling, wetness, and frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the very slow permeability. Properly designed sewage lagoons can function adequately.

Low strength, the high shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Building the roads on raised, well compacted fill material and installing a drainage system that includes roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIw. No woodland ordination symbol is assigned.

20D2—Keswick clay loam, 9 to 14 percent slopes, eroded. This strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. Individual areas are irregular in shape and range from about 10 to 25 acres in size.

Typically, the surface layer is dark brown, firm clay loam about 4 inches thick. The subsoil is about 39 inches thick. It is firm. The upper part is dark brown and strong brown, mottled clay; the next part is yellowish brown, mottled clay; and the lower part is mottled strong brown and gray clay loam. The substratum to a depth of 60 inches or more is yellowish brown, very firm clay loam. In some areas the surface layer is thicker.

Included with this soil in mapping are small areas of Lindley soils on the steeper slopes and the somewhat poorly drained Gorin soils on the higher ridgetops. Lindley soils are less clayey than the Keswick soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Keswick soil. Surface runoff is rapid. The available water capacity is moderate. Natural fertility and the content of organic matter are low. The shrink-swell potential is high. A perched water table is at a depth of 1 to 3 feet during winter and spring months.

Most areas are used as pasture, hayland, or woodland (fig. 8). This soil is suited to cultivated crops that are grown on a limited basis in rotations that include pasture and hay crops. Further water erosion is a severe hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, and grassed waterways help to prevent excessive soil loss. Areas where slopes are long enough and smooth enough can be terraced and farmed on the contour. Proper management of crop residue and green manure crops can help to control erosion, maintain or increase the content of organic matter, maintain or improve tilth, and increase the rate of water infiltration.

Growing grasses and legumes for pasture and hay is effective in controlling water erosion. This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, and switchgrass and is moderately suited to alfalfa and little bluestem. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss. Because of the slope, operating haying equipment may be hazardous.

Many areas support native hardwoods. This soil is suited to trees. Windthrow is a management concern. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil is suited to building site development and some kinds of onsite waste disposal. The shrink-swell potential and the wetness are limitations on sites for dwellings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Dwellings can be designed so that they conform to the natural slope of the land, or the site can be improved by land shaping. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can minimize the damage caused by shrinking and swelling and by frost action. The wetness and the slow permeability are severe limitations on sites for septic tank absorption fields. Properly designed sewage lagoons can function adequately if the site is leveled.

Low strength, the high shrink-swell potential, the wetness, the potential for frost action, and the slope

Figure 8.—White oak and permanent pasture in an area of Keswick clay loam, 9 to 14 percent slopes, eroded.

limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action. Cutting and filling may be needed, depending on the slope.

The land capability classification is IVe. The woodland ordination symbol is 3C.

21B—Weller silt loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on convex ridgetops in the uplands. Individual areas are irregular in shape and range from about 10 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 9 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled and firm. The upper part is yellowish brown silty clay, the next part is grayish brown silty clay, and the lower part is light brownish gray silty clay loam. In some areas the soil does not have grayish brown mottles and has less clay in the upper part of the subsoil.

Included with this soil in mapping are areas of the well drained Menfro soils on broad ridgetops. These soils have less clay than the Weller soil. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Weller soil. Surface runoff is medium. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderately low. The shrink-swell potential is high. A perched water table is at a depth of 2 to 4 feet during most winter and spring months.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, minimizes crusting, and increases the rate of water infiltration.

This soil is suited to pasture and hay. It is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, and switchgrass and is moderately suited to alfalfa and little bluestem. Water erosion during seedbed preparation is the main problem. Timely tillage and a quickly established ground cover help to prevent excessive soil loss.

This soil is suited to trees. Seedling mortality and windthrow are management concerns. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil is suited to building site development and some kinds of onsite waste disposal. The high shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can help to prevent the damage caused by shrinking and swelling and by frost action. The soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the very slow permeability. Properly designed sewage lagoons can function adequately. Leveling of the lagoon site may be necessary.

Low strength, the high shrink-swell potential, the wetness, and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIe. The woodland ordination symbol is 3C.

22B—Menfro silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on broad ridgetops in the highly dissected uplands adjacent to the flood plain along the Mississippi River. Individual areas are irregular in shape and range from about 10 to 70 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 8 inches thick. The subsurface layer is yellowish brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. It is firm. The upper part is dark yellowish brown and dark brown silty clay loam, and the lower part is dark brown silt loam. In some areas the lower part of the subsoil has grayish brown mottles.

Included with this soil in mapping are areas of the moderately well drained Weller soils on convex ridgetops. These soils have more clay in the subsoil than the Menfro soil. They make up about 5 to 10 percent of the unit.

Permeability is moderate in the Menfro soil. Surface runoff is medium. The available water capacity is high. Natural fertility also is high, and the content of organic matter is moderately low. The shrink-swell potential is moderate.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, water erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, proper management of crop residue, and green manure crops help to prevent excessive water erosion. Areas where slopes are long enough and smooth enough can be terraced and farmed on the contour.

This soil is suited to pasture and hay. It is well suited to alfalfa, tall fescue, timothy, bermudagrass, big bluestem, indiangrass, and other commonly grown legumes and warm- and cool-season grasses. No serious problems affect pasture or hayland. Water erosion is a hazard when seedlings are becoming established. Timely seedbed preparation helps to ensure rapid growth of a good plant cover.

Some small areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting. Black walnut grows well on this soil.

This soil is suited to building site development and onsite waste disposal systems. The high shrink-swell potential is a limitation on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can help to prevent the damage caused by shrinking and swelling and by frost action. Properly constructed septic tank absorption fields and properly designed sewage lagoons can function adequately. Leveling of the lagoon site may be necessary. Sealing the bottom and sides of the lagoon helps to prevent seepage.

Low strength, the potential for frost action, and the shrink-swell potential limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts minimize the damage caused by frost action and by shrinking and swelling.

The land capability classification is IIe. The woodland ordination symbol is 3A.

23C2—Winfield silt loam, 5 to 9 percent slopes, eroded. This moderately sloping, moderately well drained soil is on ridgetops and side slopes in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. Individual areas are irregular in shape and range from about 10 to 80 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is silty clay loam about 38 inches thick. The upper part is dark brown and dark yellowish brown and is friable and firm, and the lower part is light brownish gray, mottled, and firm. The substratum to a depth of 60 inches or more is light brownish gray, mottled, friable silt loam. In some small areas the subsoil has less clay. In places the lower part of the subsoil does not have grayish brown mottles.

Permeability is moderate in the Winfield soil. Surface runoff is medium. The available water capacity is high. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. It also is suited to orchards and vineyards. Further water erosion is a severe hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, stripcropping, and winter cover crops help to prevent excessive water erosion. Many areas are smooth enough and large enough to be terraced and farmed on the contour. Proper management of crop residue and green manure crops can help to control water erosion, maintain and increase the content of organic matter, maintain or improve tilth, and increase the rate of water infiltration.

This soil is suited to pasture and hay. It is well suited to alfalfa, red clover, tall fescue, timothy, bermudagrass, big bluestem, indiangrass, and other commonly grown legumes and warm- and cool-season grasses. No serious problems affect pasture or hayland. Water erosion is a hazard when seedlings are becoming established. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth of a good plant cover.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development and some kinds of onsite waste disposal. The shrink-swell potential and the wetness are limitations on sites for dwellings and small commercial buildings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Land shaping is necessary on sites for small commercial buildings because of the slope. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can help to prevent the damage caused by shrinking and swelling and by frost action. Some areas are suitable as sites for septic tank absorption fields if perimeter drains lower the water table and long laterals are used to overcome the restricted permeability. Sewage lagoons can function adequately. Leveling of the lagoon site is necessary. Sealing the bottom and sides of the lagoon helps to prevent contamination of the ground water and seepage.

Low strength, the potential for frost action, and the shrink-swell potential limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts can minimize the damage caused by frost action and by shrinking and swelling.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

23D2—Winfield silt loam, 9 to 14 percent slopes, eroded. This strongly sloping, moderately well drained soil is on side slopes in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil by tillage. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsoil is firm silty clay loam about 36 inches thick. The upper part is dark yellowish brown, the next part is yellowish brown and mottled, and the lower part is light brownish gray and mottled. The substratum to a depth of 60 inches or more is light brownish gray, mottled, friable silt loam.

Included with this soil in mapping are areas of Lindley and Vanmeter soils on the steeper side slopes. Lindley soils have glacial sand and pebbles throughout. Vanmeter soils are moderately deep. Included soils make up about 3 to 10 percent of the unit.

Permeability is moderate in the Winfield soil. Surface runoff is medium. The available water capacity is high. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A perched table is at a depth of 2.5 to 4.0 feet during most winter and spring months.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. Further water erosion is a severe hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, stripcropping, terraces, grassed waterways, and suitable crop rotations help to prevent excessive soil loss. Terraces that have steep, grassed back slopes should be used. Gullying is a serious hazard. As a result, waterways require careful design and maintenance. Proper management of crop residue and green manure crops can help to control water erosion, maintain or increase the content of organic matter, and increase the rate of water infiltration.

This soil is suited to pasture and hay. It is well suited to birdsfoot trefoil, red clover, tall fescue, timothy, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, big bluestem, and indiangrass. Water erosion during seedbed preparation and overgrazing are the main problems. A seedbed should be prepared on the contour. Timely seedbed preparation helps to ensure rapid growth of a good plant cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are needed.

Some areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development and some kinds of onsite waste disposal. The shrink-swell potential, the slope, and the wetness are limitations on sites for dwellings. Footings, foundations, and basement walls should be constructed with adequately reinforced concrete and backfilled with sand or gravel. These measures help to prevent the damage caused by shrinking and swelling. Installing drainage tile around the footings helps to prevent the damage caused by excessive wetness. Dwellings can be designed so that they conform to the natural slope of the land, or the site can be improved by land shaping. Adequate reinforcement steel, expansion joints, and a base of sand or gravel for sidewalks and driveways can minimize the damage caused by shrinking and swelling and wetness. Some areas are suitable as sites for septic tank absorption fields if perimeter drains lower the water table and long laterals are used to overcome the restricted permeability. Properly designed sewage lagoons can function adequately if the site is leveled. Sealing the bottom and sides of the lagoon helps to prevent contamination of the ground water and seepage.

Low strength, the potential for frost action, and the shrink-swell potential limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading roads so that they shed water and providing adequate roadside ditches and culverts can minimize the damage caused by frost action and by shrinking and swelling. Cutting and filling may be needed, depending on the slope.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

23E—Winfield silt loam, 14 to 25 percent slopes. This moderately steep and steep, moderately well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 4 inches thick. The subsurface layer is dark brown, friable and firm silt loam about 9 inches thick. The subsoil is mottled, firm silty clay loam about 33 inches thick. The upper part is yellowish brown, and the lower part is light brownish gray. The substratum to a depth of 60 inches or more is light brownish gray, mottled, friable silt loam.

Included with this soil in mapping are areas of the moderately deep Vanmeter soils on the lower side slopes. These soils make up about 3 to 10 percent of the unit.

Permeability is moderate in the Winfield soil. Surface runoff is rapid. The available water capacity is high. Natural fertility is medium, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A perched water table is at a depth of 2.5 to 4.0 feet during most winter and spring months.

This soil is suited to pasture. It is well suited to birdsfoot trefoil, red clover, tall fescue, timothy, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, big bluestem, and indiangrass. Water erosion during seedbed preparation and overgrazing are the main problems. The pasture should be tilled on the contour, and nurse crops or crop residue should be left on the surface. Timely seedbed preparation helps to ensure rapid growth of a good plant cover. Overgrazing should be avoided. Measures that maintain fertility and control brush are needed.

Some areas support native hardwoods. This soil is suited to trees. The hazard of water erosion, the equipment limitation, and seedling mortality are management concerns. Logging roads and skid trails should be established on the contour because of the steepness and length of slopes and the concentration of water. Seeding of disturbed areas may be necessary after the trees are harvested. In the steepest areas it may be necessary to yard the logs uphill to the logging roads or skid trails. Planting container-grown nursery stock can increase the seedling survival rate.

This soil generally is unsuited to building site development and onsite waste disposal because the slope is a severe limitation. This limitation is severe mainly because of the high cost of preparing the site for construction. The soil can be used for low-density housing if the site is extensively prepared.

The land capability classification is IVe. The woodland ordination symbol is 3R.

24E—Vanmeter silt loam, 14 to 25 percent slopes. This moderately deep, moderately steep and steep, moderately well drained soil is on side slopes along drainageways in the uplands. Individual areas are irregular in shape and range from about 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 5 inches thick. The subsoil is about 27 inches thick. It is firm. The upper part is dark brown silty clay loam, the next part is dark brown silty clay, and the lower part is dark yellowish brown silty clay. Olive yellow, weathered shale bedrock is at a depth of about 32 inches. In some areas the depth to weathered bedrock is less than 20 inches.

Included with this soil in mapping are areas of the deep Lindley and Winfield soils. These soils are higher on the side slopes than the Vanmeter soil. They make up about 5 to 10 percent of the unit.

Permeability is very slow in the Vanmeter soil. Surface runoff is rapid. The available water capacity is moderate. Natural fertility is low, and the content of organic matter is moderately low. The shrink-swell potential is high.

Most areas are used as woodland. Some are used as pasture. This soil is suited to pasture. It is moderately well suited to birdsfoot trefoil, reed canarygrass, tall fescue, big bluestem, and indiangrass and is moderately suited to orchardgrass, bermudagrass, and switchgrass. In areas where shale fragments are on the surface, tillage is difficult. Water erosion during seedbed preparation is a problem. The pasture should be tilled on the contour, and nurse crops or crop residue should be left on the surface. Overgrazing should be avoided. Measures that maintain fertility and control brush are needed.

This soil is suited to trees. The expected production of commercial timber is low, however, and generally does not justify the management required. The deep included soils are more productive than this soil. Onsite investigation is needed to determine the feasibility of intensive timber management.

This soil generally is unsuited to building site development and onsite waste disposal because the slope and the depth to bedrock are severe limitations. These limitations are severe mainly because of the high cost of preparing the site for construction. The soil can be used for low-density housing if the site is extensively prepared.

The land capability classification is VIIe. The woodland ordination symbol is 2R.

25—Moniteau silt loam. This nearly level, poorly drained soil is in high areas on flood plains. It is subject to rare flooding. Individual areas are irregular in shape and range from about 10 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsurface layer is grayish brown and light brownish gray, friable silt loam about 11 inches thick. It is mottled in the lower part. The subsoil is mottled, firm silty clay loam about 30 inches thick. It is grayish brown and gray in the upper part and grayish brown in the lower part. The substratum to a depth of 60 inches or more is grayish brown, mottled, friable silt loam.

Included with this soil in mapping are areas of the somewhat poorly drained Arbela and Westerville soils. These soils are in landscape positions similar to those of Moniteau soil. They make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Moniteau soil. Surface runoff is slow. The available water capacity is high. Natural fertility is low, and the content of organic matter is moderately low. The shrink-swell potential is moderate. A perched water table is within a depth of 1 foot during most winter and spring months.

Most areas are used for cultivated crops (fig. 9). This soil is suited to corn, soybeans, and small grain. The wetness is the main problem. Surface drainage can be improved by land grading and by shallow surface ditches. Crop damage can be expected during some years because of the flooding.

This soil is suited to pasture. It is well suited to reed

Figure 9.—Soybeans in an area of Moniteau silt loam and Darwin silty clay. Lindley loam, 14 to 20 percent slopes, is in the pastured area in the background.

canarygrass. It is moderately well suited to ladino clover, red clover, timothy, tall fescue, and switchgrass and is moderately suited to big bluestem, indiangrass, and little bluestem. The wetness is the main problem. The texture of the surface layer allows for easy seedbed preparation. A surface drainage system can improve the growing conditions for the deeper rooted species.

Some small areas support native hardwoods. This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are management concerns. The trees should be harvested and planted when the soil is dry or frozen. Planting container-grown nursery stock increases the seedling survival rate. The stands should be thinned less intensively and more frequently than stands in areas where windthrow is less likely.

This soil generally is unsuitable for building site development and onsite waste disposal because of the wetness and the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

26B—Jasper loam, 1 to 7 percent slopes. This very gently sloping and moderately sloping, well drained soil is on elongated ridges on old natural levees. Individual areas are irregular in shape and range from about 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 10 inches thick. The subsurface layer is dark brown, friable loam about 10 inches thick. The subsoil is dark yellowish brown and dark brown, firm clay loam about 22 inches thick. The substratum extends to a depth of 60 inches or more. It is dark brown. It is friable loam in the upper part and loose sand in the lower part.

Permeability is moderate in the upper part of the Jasper soil and rapid in the lower part. Surface runoff is medium. The available water capacity is high. Natural fertility is medium, and the content of organic matter is moderately low.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Planting on the contour helps to control runoff and erosion. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year helps to prevent excessive soil loss.

This soil is suited to pasture and hay. It is well suited to alfalfa, tall fescue, timothy, bermudagrass, big bluestem, indiangrass, and other commonly grown legumes and warm- and cool-season grasses. No serious problems affect pasture or hayland. Water erosion is a hazard when seedlings are becoming established. Timely seedbed preparation helps to ensure rapid growth of a good plant cover.

This soil is suited to building site development and septic tank absorption fields. No limitations affect properly designed dwellings and septic tank absorption fields. Land shaping is necessary on sites for small commercial buildings because of the slope. The soil is unsuited to sewage lagoons because of seepage.

Low strength and the potential for frost action limit this soil as a site for local roads and streets. Strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water and providing adequate roadside ditches and culverts can minimize the damage caused by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

27—Udipsamments, sloping. These gently sloping to moderately steep, excessively drained soils are in mounded areas on the flood plain along the Mississippi River. Individual areas are irregular in shape and are separated by areas of water.

Typically, the surface layer is dark yellowish brown coarse sand about 5 inches thick. The substratum to a depth of 60 inches or more is yellowish brown, loose coarse sand. In some small areas, the surface layer is about 12 inches of black, friable loam and silt loam and the substratum is dark brown, friable loam.

Included with these soils in mapping are some small areas of Jasper soils. These included soils are on the perimeter of the mapped areas. They make up about 5 percent of the unit.

Permeability is estimated to be rapid in the Udipsamments. Surface runoff is very slow. The available water capacity is estimated to be very low. Natural fertility is low, and the content of organic matter is very low.

Most areas are used for trees or support weeds. These soils are suited to trees. Seedling mortality is a management concern. Planting container-grown nursery stock increases the seedling survival rate. The dominant tree species are eastern cottonwood, American sycamore, and black willow.

These soils are suitable for building site development and septic tank absorption fields. Measures that overcome the rapid permeability are needed on sites for septic tank absorption fields. Onsite investigation is needed before building sites are selected.

Low strength limits these soils as sites for local roads and streets. Excavating some of the loose sand and then backfilling with large crushed rock can help to overcome this limitation.

These soils are not assigned a land capability classification or a woodland ordination symbol.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service or the Missouri University Extension Service.

About 127,090 acres in the county, or nearly 39 percent of the total acreage, is prime farmland. Most of the prime farmland is used as cropland. Scattered areas of this land are throughout the county. Most are in associations 1, 5, and 6, which are described under the heading "General Soil Map Units."

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures. The naturally wet soils in this county generally have been adequately drained through the application of drainage measures or because of the incidental drainage that results from farming, road building, or other kinds of land development.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help to prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Carol A. Bartles, soil scientist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Missouri University Extension Service.

The potential of the soils in Lewis County for the sustained production of food is good. About 39 percent of the acreage in the county is prime farmland. Only a small percentage of the cropland and pasture is adequately managed for conservation needs. The cropland that is not adequately managed is mainly on uplands that are farmed in a manner that causes erosion in excess of what is considered tolerable for sustained production over a long period. Some of the marginal cropland used for row crops should be converted to pasture or hayland. On most of the cropland, erosion can be held within tolerable limits by conservation practices designed for specific sites.

Water erosion is the major problem on nearly all of the sloping cropland and overgrazed pastures in the county. All of the soils that have slopes of more than 2 percent are susceptible to water erosion.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Armstrong, Leonard, Gifford, and Kilwinning soils. Water erosion also reduces the productivity of Vanmeter and other soils that tend to be droughty because they are moderately deep over bedrock. Second, water erosion on farmland results in the sedimentation of streams, lakes, and ponds. Control of water erosion minimizes this pollution and improves the quality of water for municipal use, for recreation, and for fish and wildlife. It also prolongs the useful life of ponds and lakes by keeping them from filling with sediments.

In clayey spots in many fields, seedbed preparation and tillage are difficult because the original friable surface soil has been eroded away. Such spots occur in areas of Armstrong, Leonard, Gifford, and Kilwinning soils.

Erosion-control practices provide a protective cover, help to control runoff, and increase the rate of water infiltration. A cropping system that keeps vegetation or crop residue on the surface can hold erosion losses to amounts that will not reduce the productive capacity of the soils. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. When included in crop rotations, legumes, such as clover and alfalfa, also improve tilth and provide nitrogen for the following crop.

Terraces reduce the length of slopes and thus help to control runoff and erosion. Conventional terraces are most practical on uneroded upland soils that have long, smooth slopes of less than 8 percent. Special construction and management techniques are necessary if terraces are to be effective in most of the strongly sloping areas of Lindley and Winfield soils. Terraces that have grassed back slopes reduce the gradient of the slopes. Special management techniques may be needed in areas where terracing exposes the clayey subsoil of Armstrong, Leonard, Gifford, and Kilwinning soils.

Minimizing tillage on the more sloping soils and leaving large quantities of crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and water erosion. These practices are effective on many of the soils in the county. They are less effective, however, on eroded soils that have a clayey surface layer. No-till farming, which is becoming more common in the county, is effective in controlling erosion in the more sloping areas. It can be used on many soils in the county. It requires special management techniques, however, in severely eroded areas.

Contour stripcropping helps to control water erosion by maintaining contoured strips of grasses or of grasses and legumes. The strips generally are used for hay. The areas between the strips are cultivated, and row crops are planted on the contour.

Wetness and flooding are management concerns on some of the soils used as cropland or pasture in the county. These soils are naturally wet because of their position on the landscape, restricted permeability, or both. Examples are Carlow and Chequest soils, which are on flood plains and receive runoff and overflow; Putnam soils, which are on broad, nearly level ridgetops; and Chariton soils, which are on high terraces. When these soils receive excess water, they stay wet for long periods because of restricted permeability. Water also accumulates in areas of Westerville, Kickapoo, and Blackoar soils. Excess water generally can be removed by land grading and field ditches. Land grading eliminates potholes and provides a suitable grade for irrigation. Occasional flooding can be a problem on Fatima, Arbela, and Westerville soils.

Few irrigation systems are used in the county. Presently, only the rain-gun system is used. Irrigation systems increase yields by supplying supplemental water during critical periods of crop growth. They also make double-cropping an attractive alternative. Soybeans can be planted directly into wheat stubble. The irrigation system supplies enough water to ensure germination and crop growth. The stubble is helpful in protecting the soil against erosion.

Soil fertility is naturally lower in most of the eroded soils in the county than in the uneroded soils. On all soils, however, additional plant nutrients are needed for maximum production. Most of the soils in the county are naturally acid in the upper part of the root zone and require applications of ground limestone to raise the pH and calcium level sufficiently for the optimum growth of legumes. On all soils additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Missouri University Extension Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

Tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Loss of the surface layer through water erosion reduces productivity and results in poor tilth. The surface layer contains most of the nutrients and organic matter needed for plant growth. When the surface layer is lost and material from the subsoil is mixed with the plow layer, maintaining tilth is difficult. An eroded surface puddles and crusts during periods of heavy rainfall because of poor tilth. The crust is hard when dry. As a result, it reduces the rate of water infiltration and increases the runoff rate. Regular additions of crop residue, manure, and other organic material can improve tilth.

Most of the uneroded soils in the uplands and most of the soils on bottom land along streams and on terraces have a surface layer of silt loam. These soils can be easily tilled and are good seedbeds. Generally, their structure becomes weaker if tillage is excessive and the surface is compacted. A surface crust forms during periods of heavy rainfall. Crusting can be a problem on Kilwinning, Menfro, Winfield, and other soils.

Chequest soils have a surface layer of silty clay

Figure 10.—An area of Kilwinning silt loam, 2 to 5 percent slopes, used for soybeans. Corn and soybeans are the most commonly grown crops in Lewis County.

loam, and Darwin soils have one of silty clay. Preparing a good seedbed is difficult on these soils. If the soils are worked when wet, the surface becomes a mass of hard clods as it dries. The soils should be tilled when the content of moisture is at an optimal level. Crop residue management helps to maintain the content of organic matter and improves tilth.

The content of clay is higher in the surface layer of all the eroded soils on uplands in the county than in the surface layer of uneroded soils. Also, tilth is poorer, the rate of water infiltration is slower, and the runoff rate is more rapid. Conservation practices are needed to reduce the hazard of further erosion.

Fall plowing is common in the county. It is a poor practice on most upland soils. Most of the cropland in the county consists of sloping soils that are subject to erosion if they are plowed in the fall.

The most commonly grown field crops that are suited to the soils and climate in the county are corn and soybeans. In 1978, about 43,300 acres was used for corn; 66,000 acres for soybeans (fig. 10); 1,000 acres for grain sorghum; and 4,000 acres for winter wheat, the most common close-growing crop *(15)*. Oats and rye can be grown, and grass seed could be produced from bromegrass, fescue, and orchardgrass.

The pasture and hay crops suited to the soils and climate in the county include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the most common legumes grown for hay. They also are grown in mixtures with bromegrass, tall fescue, orchardgrass, or timothy for hay and pasture.

The warm-season native grasses commonly grown in the county are big bluestem, little bluestem, indiangrass, and switchgrass. These grasses grow well during the hot summer months. They provide good-quality forage during July, August, and early September, when the cool-season grasses are dormant. The management needed in areas of warm-season grasses differs from that needed in areas of cool-season grasses.

Well and moderately well drained soils, such as

Lindley, Menfro, and Winfield, are well suited to alfalfa. Other legumes and all grasses grow well on most of the soils in the uplands. Darwin and Chequest soils are flooded occasionally and stay wet for long periods. As a result, they are not suited to all grasses. They are better suited to short-season summer annuals than to other grasses.

The major management concerns in most of the pastured areas in the county are overgrazing and gully erosion. Grazing should be controlled so that the plants survive and grow well. Keeping the grasses at a desirable height can help to control runoff and gully erosion.

Few, if any, specialty crops are grown in the county. The latest information about growing these crops can be obtained from local offices of the Missouri University Extension Service and the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Missouri University Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit *(12)*. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations or hazards that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production.

There are no class I, class V, or class VIII soils in Lewis County.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, or *s*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of water erosion unless close-growing plant cover is maintained;

w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

The capability classification of each map unit, except for Udipsamments, is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Approximately 13 percent of the land area in Lewis County is forested *(14)*. Knowledge of soils helps to provide a basic understanding of how forest types develop and tree growth occurs. White oak grows well on deep, moist soils. Hickories, post oak, and chinkapin oak are more prevalent where the rooting depth or the moisture supply is limited. The soil serves as a reservoir for moisture, provides an anchor for roots, and supplies most of the available plant nutrients. The soil properties that directly or indirectly affect these growth requirements include reaction, fertility, drainage, texture, structure, and depth. Aspect and landscape position also are important.

Available water capacity is influenced primarily by texture, rooting depth, and content of stones, shale, and chert. Deep soils that have a surface layer of silt loam, such as Winfield soils, have a high available water capacity. The content of shale and the depth to bedrock restrict the amount of available water in Vanmeter soils. A subsoil of silty clay, such as that in Leonard soils, restricts root development and the available water capacity. These limitations reduce the productive potential of the site. Although little can be done to change the limitations, selecting the best suited species can lessen the effect of the limitations.

The supply of plant nutrients affects tree growth. Many of the soils on uplands in the county have a leached subsoil in which the content of nutrients is low. Most of the soils on bottom land have a substratum that contains larger amounts of nutrients. Decomposition of a layer of leaf litter on the surface of the soil recycles nutrients that have accumulated in the forest ecosystem over long periods. Fire, excessive trampling by livestock, and erosion can result in the loss of plant nutrients. Forest management should include measures that prevent wildfires and protect the woodland from overgrazing.

Site characteristics that affect tree growth include aspect and position on the landscape. These influence such factors as the amount of available sunlight, air drainage, soil temperature, and moisture relations. Generally, north and east aspects are the best upland sites for tree growth.

Most of the woodland in the county is in areas of the Armstrong-Leonard, Keswick-Lindley-Gorin, and Winfield-Lindley-Vanmeter associations, which are described under the heading "General Soil Map Units." The primary timber type is white oak-red oak-hickory. Other common species grown are black oak, post oak, shingle oak, chinkapin oak, white ash, sugar maple, American elm, and black walnut. Almost pure stands of white oak are in some areas of Keswick, Lindley, Menfro, and other soils on north- and east-facing slopes (fig. 11). These soils can produce trees of veneer quality. Black walnut grows well on Menfro soils. The dominant species on Armstrong, Leonard, Gorin, and Vanmeter soils are post oak, chinkapin oak, elm, and hickories. White oak and northern red oak are minor components on these soils.

The Westerville-Chequest-Darwin and Blackoar-Fatima-Arbela associations are on flood plains. The soils in these associations are highly productive forest sites. The dominant timber type is elm-ash-cottonwood. The wetter areas support silver maple and black willow.

The Kilwinning-Putnam association is made up primarily of prairie soils and has a very small acreage of woodland. The woodland generally is along drainageways and in the more sloping areas.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R*, indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *L*, low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

Figure 11.—Oak trees in an area of Lindley loam, 20 to 35 percent slopes.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems of seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Missouri Department of Conservation, or the Missouri University Extension Service or from a commercial nursery.

Recreation

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

A total of 5,036 acres in Lewis County is used for recreational development *(10)*. About 98 percent of this acreage is owned by the state and 2 percent by federal, private, municipal, school, county, and other entities. The recreational facilities include areas that provide opportunities for water sports and access for boats, golf courses, hunting and fishing areas, campgrounds, ballfields, playgrounds, game courts, picnic areas, historical sites, fairgrounds, shooting ranges, trails, and wildlife-viewing areas.

Nearly 5,000 acres of state-owned land in the Deer Ridge Wildlife Area, Wakonda State Park, and Wyaconda Crossing State Forest is accessible to the public. Local residents use city parks at LaGrange and Canton. Several federal, state, and municipal access sites provide boat-launching facilities to the major rivers. Federally owned islands in the Mississippi River are used for recreational activities.

In 1974, the county had 15 private and semiprivate commercial recreational enterprises *(5)*. Currently, 10 of these remain in operation. They include fishing lakes, a swimming pool, boat- rental areas, marinas, a country club, a scout camp, riding trails, and hunting and saddle clubs. Additional campgrounds and fishing areas are the major kinds of recreational areas needed in the county.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

Lewis County is among the 21 counties in Missouri that make up the Northeast Riverbreaks Zoogeographic Region *(8)*. The county is a transition zone between the prairie and the Ozark Border. Its fertile soils and varied land types provide a variety and profusion of plants. The various kinds of plants provide excellent wildlife cover.

Originally, the county was covered with a mixture of trees and prairie grasses. Currently, about 46 percent of the land area is cultivated cropland, 20 percent is grassland, and 34 percent is commercial forest or other woodland. The acreage of woodland includes areas of the smaller woody species, such as shrubs and brush *(3)*. The Keswick-Lindley-Gorin and Winfield-Lindley-Vanmeter associations, which are described under the heading "General Soil Map Units," are the only associations in the county that dominantly support forest vegetation.

The deer population in the county is good or excellent. The carrying capacity for this animal has been reached. The deer are hunted mainly by local residents and by people from the St. Louis metropolitan area. The turkey population is good and is rapidly expanding into the available habitat throughout the county. The squirrel population is good. A small population of woodcocks inhabits the county.

The county has a fair population of furbearers. Rising fur values have resulted in increased hunting and trapping pressure during the past several years. Raccoon, muskrat, opossum, coyote, striped skunk, beaver, mink, and gray fox are the principal species sought by trappers. Organized coyote hunting is gaining in popularity. A small but stable bobcat population inhabits the county.

The Kilwinning-Putnam, Armstrong-Leonard, and Blackoar-Fatima-Arbela associations provide most of the openland wildlife habitat in the county. Soybeans, corn, and winter wheat are the principal grain crops. Much of the original grassland has been converted to cropland. Herbaceous vegetation appears to be the most scarce of the different habitat cover types. An increase in the size of fields, fall tillage, and the loss of wooded travel lanes in areas of cropland have a detrimental effect on openland wildlife habitat in all areas of the county, except for the Winfield-Lindley-Vanmeter association.

The quail and rabbit populations are excellent in the county. Hunting pressure has been heavy on both of these game animals. The population of doves is good and is increased each year by migratory flights of these birds. A small population of pheasants inhabits the northern part of the county. The population of songbirds is good or excellent on all of the habitat types.

No areas of the original prairie remain in the county. A small population of badgers, however, inhabits the county. There are virtually no other prairie wildlife species in the county. An excellent population of bald eagles inhabits areas along the Mississippi River. Canada geese have been stocked on an experimental basis near Canton.

Wetland wildlife habitat is by far the most scarce of the three broad habitat types in the county. Nearly all of the wetlands and waterfowl hunting areas in the county are in areas of the Westerville-Chequest-Darwin association along the Mississippi River. The major concentration of waterfowl and related shore birds is along the Mississippi River.

The rivers, streams, lakes, and farm ponds in the county provide opportunities for fishing. The county has 112 miles of permanent streams *(7)*. The Mississippi River, which borders the county for 22 miles, is heavily fished. Commercial fishermen catch mainly carp, buffalo, catfish, and some paddlefish. The fish caught below the dams include white bass, walleye, sauger, and drum. Channel catfish, bass, suckers, paddlefish, bluegill, river herring, and crappie are caught in backwater areas.

The better fishing rivers are the North Fabius, Middle Fabius, and Wyaconda Rivers. The principal stream fish include channel catfish, flathead catfish, smallmouth bass, buffalo, drum, carp, bluegill, and green sunfish.

The opportunities for impoundment fishing are limited in the county. The areas that are open to the public include Deer Ridge Lake (fig. 12); Wakonda Park Lake; the city reservoirs at Lewistown, Labelle, and Ewing; and several borrow pit lakes. Small watershed lakes provide additional opportunities for fishing. The county has several hundred farm ponds and small lakes. Most of these have been stocked with largemouth bass, channel catfish, and bluegill.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be

Figure 12.—Deer Ridge Lake in the Deer Ridge Wildlife Area. The lake provides opportunities for fishing.

expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, millet, soybeans, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are bluegrass, tall fescue, switchgrass, orchardgrass, indiangrass, alfalfa, trefoil, and crownvetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridgepea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwoods and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, wild plum, sumac, persimmon, and sassafras. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are autumn olive, crabapple, Amur honeysuckle, and hazelnut.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cutgrass, cattail, rushes, sedges, and buttonbush.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, mourning dove, cottontail, woodchuck, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreation uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, and shrink-swell potential can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. The depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 foot to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability in the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to help to control water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

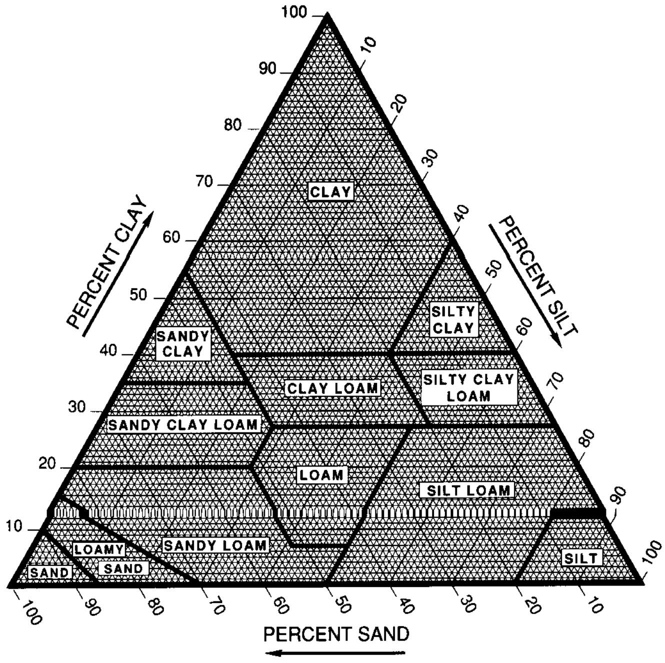

Figure 13.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 13). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated content of clay in each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(13)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(11)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(13)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Arbela Series

The Arbela series consists of deep, poorly drained, moderately slowly permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Arbela silt loam, approximately 2,200 feet north and 900 feet west of the southeast corner of sec. 36, T. 60 N., R. 7 W.

Ap—0 to 13 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; neutral; abrupt smooth boundary.

E—13 to 22 inches; grayish brown (10YR 5/2) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak thin platy structure parting to moderate fine granular; friable; few fine roots; few fine pores; medium acid; abrupt smooth boundary.

Btg—22 to 43 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; moderate fine angular and subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; strongly acid; gradual smooth boundary.

Bg—43 to 60 inches; dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) silty clay loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine pores; medium acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silt loam, but silty clay loam is within the range. The E horizon has value of 4 or 5 and chroma of 1 or 2. The Btg horizon has value of 4 or 5.

Armstrong Series

The Armstrong series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in a thin layer of pedisediments and in the underlying weathered glacial till. Slopes range from 5 to 9 percent.

Typical pedon of Armstrong loam, 5 to 9 percent slopes, eroded; 1,000 feet north and 100 feet east of the southwest corner of sec. 4, T. 60 N., R. 9 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; common fine roots; few fine pores; medium acid; clear smooth boundary.

BE—6 to 10 inches; brown (10YR 4/3) clay loam; mixed with reddish brown (5YR 4/4) material; weak fine subangular blocky structure; friable; common fine roots; few fine pores; medium acid; clear smooth boundary.

Bt1—10 to 19 inches; dark brown (7.5YR 4/4) clay loam; common fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular and angular blocky structure; firm; few fine roots; few fine pores; common distinct clay films; very strongly acid; clear smooth boundary.

2Bt2—19 to 32 inches; strong brown (7.5YR 5/6) clay; few fine prominent grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; very firm; few fine roots; few fine pores; common distinct clay films; common black stains; medium acid; gradual smooth boundary.

2Bt3—32 to 39 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct gray (10YR 6/1) mottles; moderate medium subangular blocky structure; very firm; few fine pores; few faint clay films; medium acid; gradual smooth boundary.

2Bt4—39 to 46 inches; yellowish brown (10YR 5/4) clay loam; common fine prominent red (2.5YR 4/6) and few fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; strongly acid; clear smooth boundary.

2Bt5—46 to 54 inches; mottled yellowish brown (10YR 5/4), grayish brown (10YR 5/2), and strong brown (7.5YR 5/6) clay loam; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; strongly acid; clear smooth boundary.

2C—54 to 60 inches; yellowish brown (10YR 5/6) clay loam; few fine prominent gray (10YR 6/1) mottles; massive; very firm; medium acid.

The A horizon has chroma of 1 or 2. The Ap horizon is dominantly loam, but clay loam is within the range. The Bt horizon has hue of 5YR to 10YR and chroma of 3 to 6.

Blackoar Series

The Blackoar series consists of deep, poorly drained, moderately permeable soils on flood plains. These soils formed in silty recent alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Blackoar silt loam, approximately 2,000 feet north and 300 feet east of the southwest corner of sec. 16, T. 61 N., R. 9 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; neutral; clear smooth boundary.

A—9 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.

Bg—14 to 36 inches; dark gray (10YR 4/1) silt loam; few fine distinct dark brown (10YR 3/3) mottles; weak fine subangular blocky structure; friable; few fine roots; few fine pores; medium acid; clear smooth boundary.

Cg—36 to 60 inches; gray (10YR 5/1) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; appears massive but has weak bedding planes; friable; few fine roots; few fine pores; medium acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg and Cg horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of less than 2. They have mottles with higher chroma.

Chariton Series

The Chariton series consists of deep, poorly drained, slowly permeable soils on high stream terraces. These soils formed in loess and alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Chariton silt loam, approximately 2,500 feet north and 100 feet east of the southwest corner of sec. 10, T. 62 N., R. 8 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine roots; common fine pores; slightly acid; abrupt smooth boundary.

E—9 to 17 inches; grayish brown (10YR 5/2) silt loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak thin platy structure parting to moderate fine granular; friable; few fine roots; common fine pores; strongly acid; abrupt smooth boundary.

Bt1—17 to 25 inches; dark gray (10YR 4/1) silty clay; few fine prominent yellowish brown (10YR 5/8) mottles; moderate fine subangular blocky structure; firm; few fine roots; few fine pores; common distinct clay films; strongly acid; clear smooth boundary.

Bt2—25 to 40 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few fine roots; few fine pores; common distinct clay films; medium acid; clear smooth boundary.

Bt3—40 to 51 inches; grayish brown (10YR 5/2) silty clay; many medium prominent yellowish brown (10YR 5/6) and common medium prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine pores; common fine sand grains; few distinct clay films; slightly acid; gradual smooth boundary.

2C—51 to 60 inches; mottled gray (10YR 5/1) and yellowish brown (10YR 5/6) clay loam; massive; few fine pores; few distinct clay films in pores; firm; slightly acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 1 or 2. The 2C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 or 2.

Chequest Series

The Chequest series consists of deep, poorly drained, moderately slowly permeable soils on flood plains. These soils formed in silty and clayey alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Chequest silty clay loam, approximately 60 feet south and 2,350 feet east of the northwest corner of sec. 7, T. 60 N., R. 6 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; few fine roots; few fine pores; neutral; clear smooth boundary.

A—7 to 17 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; slightly acid; clear smooth boundary.

Btg1—17 to 36 inches; dark gray (10YR 4/1) silty clay loam; many fine prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; medium acid; clear smooth boundary.

Btg2—36 to 48 inches; gray (10YR 5/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; firm; few faint clay films; medium acid; clear smooth boundary.

Btg3—48 to 60 inches; dark gray (10YR 4/1) silty clay; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; medium acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y.

Darwin Series

The Darwin series consists of deep, very poorly drained, very slowly permeable soils on flood plains. These soils formed in clayey alluvium in slack-water areas. Slopes are 0 to 1 percent.

Typical pedon of Darwin silty clay, approximately 50 feet south and 100 feet west of the northeast corner of sec. 31, T. 60 N., R. 6 W.

Ap—0 to 12 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak medium granular structure; firm; neutral; abrupt smooth boundary.

Bg1—12 to 19 inches; dark gray (10YR 4/1) silty clay; few fine prominent dark yellowish brown (10YR 3/6) mottles; weak fine subangular and angular blocky structure; firm; few fine roots; few fine pores; neutral; gradual smooth boundary.

Bg2—19 to 42 inches; dark gray (N 4/0) silty clay; common fine prominent dark yellowish brown (10YR 3/6) mottles; moderate medium subangular and angular blocky structure; firm; few fine roots; few fine pores; neutral; gradual smooth boundary.

Cg—42 to 60 inches; dark gray (N 4/0) silty clay; few fine prominent dark yellowish brown (10YR 3/4) mottles; massive; firm; few fine roots; few fine pores; neutral.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is dominantly silty clay, but silty clay loam is within the range. The Bg horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 3 to 5 and chroma of 0 or 1. It is silty clay or clay. Many of the peds in this horizon have shiny pressure faces. The Cg horizon has hue of 5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 or 1.

Fatima Series

The Fatima series consists of deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Fatima silt loam, approximately 2,350 feet south and 600 feet west of the northeast corner of sec. 33, T. 60 N., R. 6 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; neutral; clear smooth boundary.

A—9 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few fine faint dark brown (10YR 3/3) mottles; moderate fine granular structure; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.

Bw1—18 to 32 inches; dark grayish brown (10YR 4/2) silt loam; few fine prominent dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.

Bw2—32 to 45 inches; grayish brown (10YR 5/2) silt loam; common fine prominent dark brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine roots; few fine pores; weak bedding planes; slightly acid; clear smooth boundary.

C—45 to 60 inches; grayish brown (10YR 5/2) silt loam; common fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; weak bedding planes; few fine roots; few fine pores; slightly acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam and loam.

Gifford Series

The Gifford series consists of deep, poorly drained, very slowly permeable soils on stream terraces. These soils formed in a thin layer of loess and in alluvial sediments. Slopes range from 3 to 9 percent.

Typical pedon of Gifford silt loam, 3 to 9 percent slopes, eroded, approximately 750 feet south and 950 feet east of the northwest corner of sec. 28, T. 60 N., R. 9 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; slightly acid; abrupt smooth boundary.

BA—5 to 11 inches; brown (10YR 5/3) silty clay loam; common fine prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular and angular blocky structure; firm; few fine roots; few fine pores; common faint clay films; slightly acid; clear smooth boundary.

Btg1—11 to 17 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent strong brown (7.5YR 5/8) and few fine faint gray (10YR 5/1) mottles; moderate fine subangular blocky structure; firm; few fine roots; few fine pores; common faint clay films; strongly acid; clear smooth boundary.

Btg2—17 to 32 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; few fine pores; common faint clay films; slightly acid; clear smooth boundary.

2C—32 to 60 inches; mottled gray (10YR 6/1) and yellowish brown (10YR 5/6) clay loam; massive; firm; few fine pores; neutral.

The A horizon has value of 3 or 4 and chroma of 1 or 2. The Bt horizon has chroma of 1 or 2. Many of the peds in this horizon have shiny pressure faces. The 2C horizon has hue of 5Y, 2.5Y, or 10YR, value of 4 to 6, and chroma of 1 or 2. It is loam or clay loam.

Gorin Series

The Gorin series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a thin layer of loess and in the underlying pedisediments. Slopes range from 5 to 9 percent.

Typical pedon of Gorin silt loam, 5 to 9 percent slopes, approximately 1,200 feet south and 750 feet west of the northeast corner of sec. 30, T. 60 N., R. 7 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few fine roots; few fine pores; medium acid; abrupt smooth boundary.

E—3 to 6 inches; brown (10YR 5/3) silt loam; weak thin platy structure parting to moderate fine granular; very friable; few fine roots; common fine pores; strongly acid; clear smooth boundary.

Bt1—6 to 13 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; firm; few medium roots; common fine pores; few faint clay films; strongly acid; clear smooth boundary.

Bt2—13 to 24 inches; dark yellowish brown (10YR 4/4) silty clay; few fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; very firm; few medium and common fine roots; few fine pores; few faint clay films; strongly acid; clear smooth boundary.

Bt3—24 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; firm; few faint clay films; few fine roots; few fine pores; strongly acid; clear smooth boundary.

2Bt4—40 to 52 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine roots; few fine pores; few distinct clay films in old channels; strongly acid; gradual smooth boundary.

2Bt5—52 to 60 inches; mottled yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) clay loam; weak subangular blocky structure; firm; few black oxide stains; few fine roots; few fine pores; few distinct clay films in old root channels; medium acid.

The A horizon has value of 3 or 4 and chroma of 1 or 2. The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y and chroma of 2 to 4. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6.

Jasper Series

The Jasper series consists of deep, well drained soils on elongated ridges that are natural levees. These soils formed in alluvial outwash derived from the old channel of the Mississippi River. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 1 to 7 percent.

Typical pedon of Jasper loam, 1 to 7 percent slopes, approximately 200 feet north and 2,025 feet east of the southwest corner of sec. 25, T. 60 N., R. 6 W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; neutral; clear smooth boundary.

A—10 to 20 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; few fine roots; few fine pores; neutral; clear smooth boundary.

Bt1—20 to 31 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; firm; few fine roots; few fine pores; very few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—31 to 42 inches; dark brown (10YR 4/3) clay loam; weak fine subangular blocky structure; firm; few fine roots; few fine pores; very few faint clay films on faces of peds; slightly acid; clear smooth boundary.

C1—42 to 53 inches; dark brown (10YR 4/3) loam; massive; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.

C2—53 to 60 inches; dark brown (10YR 3/3) sand; single grain; loose; slightly acid.

The A horizon has value of 2 or 3 and chroma of 1 to 3. The Bt horizon has value of 3 or 4. It is clay loam or loam.

Keswick Series

The Keswick series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in a thin layer of pedisediments and in the underlying weathered glacial till. Slopes range from 9 to 14 percent.

Typical pedon of Keswick clay loam, 9 to 14 percent slopes, eroded; 100 feet north and 1,500 feet east of the southwest corner of sec. 30, T. 60 N., R. 8 W.

Ap—0 to 4 inches; dark brown (10YR 4/3) clay loam, pale brown (10YR 6/3) dry; moderate fine subangular blocky structure; firm; few fine roots; slightly acid; abrupt smooth boundary.

2Bt1—4 to 13 inches; dark brown (7.5YR 4/4) clay;

many fine prominent red (2.5YR 4/6) and few fine prominent reddish gray (5YR 5/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films; strongly acid; clear smooth boundary.

2Bt2—13 to 20 inches; strong brown (7.5YR 5/6) clay; common medium prominent brown (7.5YR 5/2) and few fine prominent red (2.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine pores; few faint clay films; very strongly acid; gradual smooth boundary.

2Bt3—20 to 33 inches; yellowish brown (10YR 5/6) clay; few medium prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine pores; few faint clay films; very strongly acid; clear smooth boundary.

2Bt4—33 to 43 inches; mottled strong brown (7.5YR 5/6) and gray (10YR 5/1) clay loam; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; common black stains; medium acid; clear smooth boundary.

2C—43 to 60 inches; yellowish brown (10YR 5/4) clay loam; massive; very firm; few fine pores; few black stains; medium acid.

The A horizon has value of 3 or 4. The 2Bt horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 6. It is clay loam or clay. The 2C horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 1 to 6.

Kickapoo Series

The Kickapoo series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in stratified alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Kickapoo fine sandy loam, approximately 500 feet south and 3,000 feet east of the northwest corner of sec. 9, T. 60 N., R. 7 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak medium platy structure; friable; few fine roots; neutral; abrupt smooth boundary.

C1—5 to 10 inches; brown (10YR 5/3) and dark grayish brown (10YR 4/2) sandy loam; thin bands of yellowish brown (10YR 5/6) material; weak thin platy structure; friable; few fine roots; neutral; clear smooth boundary.

C2—10 to 14 inches; weakly stratified dark yellowish brown (10YR 4/4) and dark brown (10YR 4/3) fine sandy loam; massive; friable; few fine roots; neutral; clear smooth boundary.

C3—14 to 26 inches; weakly stratified dark brown (10YR 4/3) and dark grayish brown (10YR 4/2) fine sandy loam; massive; friable; few fine roots; neutral; abrupt smooth boundary.

Ab—26 to 35 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium platy structure; friable; few fine roots; neutral; abrupt smooth boundary.

C′1—35 to 46 inches; dark brown (10YR 4/3) fine sandy loam; massive; friable; neutral; clear smooth boundary.

C′2—46 to 60 inches; brown (10YR 5/3) silt loam; massive; friable; neutral.

The A horizon has value of 3 or 4 and chroma of 2 or 3. It is dominantly fine sandy loam, but loam is within the range. The C horizon has value of 3 to 6 and chroma of 2 to 4. In some pedons it has mottles with chroma of less than 3. It is sandy loam, fine sandy loam, silt loam, or sand.

Kilwinning Series

The Kilwinning series consists of deep, poorly drained, very slowly permeable soils on uplands. These soils formed in loess. Slopes range from 2 to 5 percent.

Typical pedon of Kilwinning silt loam, 2 to 5 percent slopes, approximately 2,600 feet south and 2,500 feet east of the northwest corner of sec. 9, T. 60 N., R. 9 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

Btg1—9 to 15 inches; dark gray (10YR 4/1) silty clay; common fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine pores; common faint clay films; strongly acid; clear smooth boundary.

Btg2—15 to 23 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct dark gray (10YR 4/1) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; few fine pores; few faint clay films; medium acid; clear smooth boundary.

Btg3—23 to 27 inches; dark grayish brown (10YR 4/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; common fine pores; common faint clay films; medium acid; clear smooth boundary.

Btg4—27 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay; many medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; few fine pores; common faint clay films; medium acid; clear smooth boundary.

Btg5—31 to 47 inches; gray (10YR 5/1) silty clay loam; few medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; few black stains; slightly acid; clear smooth boundary.

Btg6—47 to 60 inches; gray (10YR 5/1) silty clay loam; many coarse distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; few black stains; neutral.

The Ap horizon is 6 to 9 inches thick. It has value of 2 or 3 and chroma of 1 or 2. It is dominantly silt loam, but the range includes silty clay loam. Many of the peds in the Bt horizon have shiny pressure faces.

Leonard Series

The Leonard series consists of deep, poorly drained, slowly permeable soils on uplands. These soils formed in a thin layer of loess and in the underlying pedisediments. Slopes range from 5 to 9 percent.

Typical pedon of Leonard silty clay loam, 5 to 9 percent slopes, eroded, approximately 100 feet south and 250 feet east of the center of sec. 10, T. 61 N., R. 9 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; neutral; clear smooth boundary.

Btg1—7 to 25 inches; dark grayish brown (10YR 4/2) silty clay; many fine prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine pores; common prominent clay films; strongly acid; clear smooth boundary.

Btg2—25 to 30 inches; gray (10YR 5/1) silty clay; many fine prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few fine roots; few fine pores; common prominent clay films; few clean sand grains; strongly acid; clear smooth boundary.

2Btg3—30 to 48 inches; gray (10YR 5/1) silty clay; common fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; very firm; few fine roots; few fine pores; few faint clay films; common clean sand grains; slightly acid; clear smooth boundary.

2Btg4—48 to 60 inches; mottled light olive gray (5Y 6/2) and grayish brown (2.5Y 5/2) silty clay; few medium prominent yellowish brown (10YR 5/6) mottles; massive; very firm; few fine pores; few faint clay films; few fine white chert fragments and common clean sand grains; neutral.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is dominantly silty clay loam, but silt loam is within the range. Many of the peds in the Btg horizon have shiny pressure faces.

Lindley Series

The Lindley series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 14 to 35 percent.

Typical pedon of Lindley loam, 20 to 35 percent slopes, approximately 1,500 feet south and 1,500 feet west of the northeast corner of sec. 34, T. 60 N., R. 8 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; very friable; few fine roots; few fine pores; strongly acid; abrupt smooth boundary.

E—3 to 7 inches; dark grayish brown (10YR 4/2) loam; weak thin platy structure parting to moderate fine granular; very friable; few fine roots; few fine pores; very strongly acid; clear smooth boundary.

Bt1—7 to 11 inches; yellowish brown (10YR 5/6) clay loam; weak fine subangular blocky structure; firm; few fine and medium roots; few fine pores; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—11 to 20 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—20 to 33 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; very firm; few fine roots; few fine pores; few faint clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt4—33 to 46 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent gray (10YR 6/1) mottles; weak medium subangular blocky structure; very firm; few fine roots; few fine pores; few faint clay films on faces of peds; very strongly acid; gradual smooth boundary.

C1—46 to 57 inches; yellowish brown (10YR 5/6), brown (10YR 5/3), grayish brown (10YR 5/2), and gray (10YR 6/1) clay loam; massive; very firm; few fine roots; few fine pores; few distinct clay films in root channels; common black stains; slightly acid; gradual smooth boundary.

C2—57 to 60 inches; grayish brown (10YR 5/2) clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; massive; very firm; few fine roots; few fine pores; common black stains; neutral.

The A horizon has value of 3 or 4 and chroma of 1 or 2. It is dominantly loam, but silt loam is within the range. The Bt horizon has value of 4 or 5 and chroma of 4 to 6.

Menfro Series

The Menfro series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in thick deposits of loess. Slopes range from 2 to 5 percent.

Typical pedon of Menfro silt loam, 2 to 5 percent slopes, approximately 2,000 feet north and 1,000 feet east of the southwest corner of sec. 11, T. 60 N., R. 6 W.

Ap—0 to 8 inches; dark brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate fine granular structure; friable; few fine roots; few fine pores; slightly acid; abrupt smooth boundary.

E—8 to 13 inches; yellowish brown (10YR 5/4) silt loam; weak thin platy structure parting to moderate fine granular; friable; few fine roots; few fine pores; medium acid; clear smooth boundary.

Bt1—13 to 24 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; strongly acid; clear smooth boundary.

Bt2—24 to 35 inches; dark brown (7.5YR 4/4) silty clay loam; moderate fine subangular and angular blocky structure; firm; few fine roots; few fine pores; few faint clay films; medium acid; clear smooth boundary.

Bt3—35 to 43 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; medium acid; clear smooth boundary.

Bt4—43 to 60 inches; dark brown (10YR 4/3) silt loam; weak fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; slightly acid.

The A horizon has value of 3 or 4 and chroma of 2 or 3.

Moniteau Series

The Moniteau series consists of deep, poorly drained, moderately slowly permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Moniteau silt loam, approximately 3,100 feet north and 1,600 feet west of the southeast corner of sec. 9, T. 62 N., R. 8 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

E1—7 to 10 inches; grayish brown (10YR 5/2) silt loam; weak thin platy structure parting to moderate fine granular; friable; few fine roots; few fine pores; medium acid; clear smooth boundary.

E2—10 to 18 inches; light brownish gray (10YR 6/2) silt loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak thin platy structure parting to moderate fine granular; friable; few fine roots; few fine pores; medium acid; clear smooth boundary.

Btg1—18 to 33 inches; grayish brown (10YR 5/2) and gray (10YR 5/1) silty clay loam; few fine prominent yellowish brown (10YR 5/6) and common fine prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular and angular blocky structure; firm; few fine roots; few fine pores; few faint clay films; very strongly acid; clear smooth boundary.

Btg2—33 to 48 inches; grayish brown (10YR 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) and common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; strongly acid; gradual smooth boundary.

Cg—48 to 60 inches; grayish brown (10YR 5/2) silt loam; many medium prominent strong brown (7.5YR 5/6) mottles; black (10YR 2/1) oxide masses; massive; friable; few fine pores; few faint clay films in pores; medium acid.

The A horizon has value of 4 or 5 and chroma of 1 or 2. The Btg horizon has value of 4 to 6.

Putnam Series

The Putnam series consists of deep, poorly drained, very slowly permeable soils on uplands. These soils formed in thick deposits of loess. Slopes range from 0 to 2 percent.

Typical pedon of Putnam silt loam, approximately 250 feet north and 100 feet west of the center of sec. 4, T. 61 N., R. 9 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.
E—9 to 17 inches; grayish brown (10YR 5/2) silt loam; few fine distinct yellowish brown (10YR 5/4) mottles; weak thin platy structure parting to moderate fine granular; friable; common fine roots; common fine and few medium pores; slightly acid; abrupt smooth boundary.
Bt—17 to 21 inches; dark grayish brown (10YR 4/2) silty clay; many fine prominent yellowish red (5YR 4/6) mottles; moderate medium angular blocky structure; very firm; few fine roots; few fine pores; many distinct clay films; strongly acid; clear smooth boundary.
Btg1—21 to 29 inches; grayish brown (10YR 5/2) silty clay; few fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; few fine pores; many distinct clay films; strongly acid; clear smooth boundary.
Btg2—29 to 37 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent yellowish red (5YR 4/6 and 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine roots; few fine pores; common distinct clay films; strongly acid; clear smooth boundary.
Btg3—37 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; firm; few fine pores; common distinct clay films; strongly acid.

The Ap horizon has chroma of 1 or 2. The E horizon has value of 5 or 6 and chroma of 1 or 2. The Bt horizon has chroma of 1 or 2.

Vanmeter Series

The Vanmeter series consists of moderately deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in material weathered from shale. Slopes range from 14 to 25 percent.

Typical pedon of Vanmeter silt loam, 14 to 25 percent slopes, approximately 200 feet north and 450 feet east of the southwest corner of sec. 25, T. 61 N., R. 8 W.

A—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; neutral; clear smooth boundary.
BA—5 to 10 inches; dark brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; firm; few fine roots; few fine pores; neutral; clear smooth boundary.
Bw1—10 to 18 inches; dark brown (7.5YR 4/4) silty clay; moderate fine angular and subangular blocky structure; firm; few medium and few fine roots; few fine pores; slightly acid; clear smooth boundary.
Bw2—18 to 25 inches; dark yellowish brown (10YR 4/6) silty clay; weak medium subangular blocky structure; firm; few medium and few fine roots; few fine pores; slightly acid; clear smooth boundary.
Bw3—25 to 32 inches; dark yellowish brown (10YR 4/6) silty clay; weak fine subangular blocky structure; firm; few medium and few fine roots; few fine pores; slightly acid; clear smooth boundary.
Cr—32 to 60 inches; olive yellow (2.5Y 6/8), weathered shale bedrock; strong effervescence; mildly alkaline.

The A horizon has value of 4 or 5. The B horizon has hue of 2.5Y to 7.5YR, value of 4 to 6, and chroma of 2 to 6. It is dominantly silty clay, but clay is within the range.

Vigar Series

The Vigar series consists of deep, moderately well drained, moderately slowly permeable soils on foot slopes in the uplands. These soils formed in local alluvium that eroded from soils that formed in loess and glacial till. Slopes range from 2 to 5 percent.

Typical pedon of Vigar loam, 2 to 5 percent slopes, approximately 500 feet north and 1,200 feet east of the southwest corner of sec. 31, T. 60 N., R. 6 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; slightly acid; clear smooth boundary.
A1—8 to 20 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.
A2—20 to 26 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; few fine roots; few fine pores; slightly acid; clear smooth boundary.
Bt1—26 to 35 inches; dark brown (10YR 4/3) clay loam; few fine faint dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; medium acid; gradual smooth boundary.
Bt2—35 to 44 inches; dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) clay loam; few fine prominent dark brown (7.5YR 4/4) mottles;

moderate fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; medium acid; gradual smooth boundary.

Bt3—44 to 60 inches; brown (10YR 5/3) clay loam; common fine distinct dark brown (7.5YR 4/4) and few fine faint grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; firm; few fine roots; few fine pores; few faint clay films; medium acid.

The Bt horizon has value of 3 to 5 and chroma of 2 to 4.

Weller Series

The Weller series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 2 to 5 percent.

Typical pedon of Weller silt loam, 2 to 5 percent slopes, approximately 2,600 feet south and 500 feet east of the northwest corner of sec. 9, T. 60 N., R. 6 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; few fine roots; neutral; clear smooth boundary.

E—8 to 17 inches; grayish brown (10YR 5/2) silt loam; few fine faint gray (10YR 5/1) mottles; moderate thin platy structure parting to moderate fine granular; friable; few fine roots; few fine pores; very strongly acid; abrupt smooth boundary.

Bt1—17 to 36 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; few fine pores; few prominent clay films; very strongly acid; clear smooth boundary.

Bt2—36 to 51 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent strong brown (7.5YR 5/8) mottles; weak medium subangular blocky structure; firm; few fine pores; few faint clay films; strongly acid; clear smooth boundary.

Bt3—51 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent strong brown (7.5YR 5/8) mottles; weak fine subangular blocky structure; firm; common fine pores; common prominent clay films in pores; strongly acid.

The A horizon has value of 3 or 4 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has value of 4 to 6 and chroma of 2 to 6. It has mottles with higher or lower chroma. The C horizon, if it occurs, has value of 4 to 6 and chroma of 2 to 6.

Westerville Series

The Westerville series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Westerville silt loam, approximately 100 feet north and 1,150 feet west of the southeast corner of sec. 17, T. 60 N., R. 9 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; many fine roots; few fine pores; strongly acid; abrupt smooth boundary.

AC—9 to 19 inches; grayish brown (10YR 5/2) silt loam; few fine faint dark brown (10YR 3/3) mottles; weak medium platy structure parting to weak fine granular; very friable; common fine roots; common fine pores; strongly acid; clear smooth boundary.

Cg1—19 to 26 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine faint dark yellowish brown (10YR 4/4) mottles; weak coarse subangular blocky structure; firm; many white (10YR 8/1) silt coatings; common fine pores; very strongly acid; gradual smooth boundary.

Cg2—26 to 35 inches; grayish brown (10YR 5/2) silty clay loam; dark grayish brown (10YR 4/2) coatings; few fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common fine pores; strongly acid; gradual smooth boundary.

Cg3—35 to 47 inches; gray (10YR 5/1) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; dark grayish brown (10YR 4/2) coatings in pores; common fine pores; strongly acid; gradual smooth boundary.

Cg4—47 to 60 inches; dark grayish brown (10YR 4/2) silt loam; common fine prominent yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; firm; common fine pores; medium acid.

The A horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon has value of 4 to 6.

Winfield Series

The Winfield series consists of deep, moderately well drained, moderately permeable soils on uplands. These soils formed in thick deposits of loess. Slopes range from 5 to 25 percent.

Typical pedon of Winfield silt loam, 5 to 9 percent slopes, eroded, approximately 150 feet north and 1,250 feet west of the southeast corner of sec. 2, T. 60 N., R. 6 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine granular structure; friable; few fine roots; neutral; clear smooth boundary.

BA—6 to 10 inches; dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; friable; few fine roots; few fine pores; medium acid; clear smooth boundary.

Bt1—10 to 22 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak fine subangular blocky structure; firm; few fine roots; few fine pores; many distinct clay films; strongly acid; clear smooth boundary.

Bt2—22 to 33 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine angular and subangular blocky structure; firm; few fine roots; few fine pores; many distinct clay films; strongly acid; clear smooth boundary.

Btg—33 to 44 inches; light brownish gray (10YR 6/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) and few medium faint brown (10YR 5/3) mottles; weak medium subangular blocky structure; firm; few fine roots; common fine pores; many distinct clay films; medium acid; clear smooth boundary.

Cg—44 to 60 inches; light brownish gray (2.5Y 6/2) silt loam; common medium prominent yellowish red (5YR 4/6) mottles; massive; common fine pores; few distinct clay films in pores; friable; medium acid.

The Ap horizon has chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 6. The Cg horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 to 4.

Factors of Soil Formation

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of the soil are determined by the kind of parent material; the plant and animal life on and in the soil; the climate under which the soil-forming factors were active; the relief, or lay of the land; and the length of time that the forces of soil formation have been active.

Parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Plant and animal life, chiefly plants, are active factors of soil formation. Climate determines the amount of water available for leaching and the amount of heat available for physical and chemical changes. Together, climate and plant and animal life act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. Relief commonly modifies the effects of the other factors. Finally, time is required for the transformation of the parent material into a soil. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated that few generalizations can be made about the effect of any one factor unless conditions are specified for the other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The formation or the deposition of this material is the first step in the development of a soil profile. The characteristics of the material determine the limits of the chemical and mineralogical composition of the soil. The soils in Lewis County formed mainly in four kinds of parent material, alone or in combinations of two or more. These are material weathered from bedrock; glacial till, or ice-deposited material; loess, or wind-deposited material; and alluvium, or water-deposited material. Of lesser importance is colluvium, which was transported short distances downslope by the action of water and gravity.

The residuum in this county is material weathered from limestone, sandstone, and shale. Vanmeter soils formed in material weathered from shale.

Glacial material is made up of clay, silt, sand, gravel, stones, and a few boulders. Much of the material in the glacial till in Lewis County was moved long distances, but some of it is of fairly local origin. The glacial till ranges from a few feet to many feet in thickness. Armstrong and Lindley soils formed in glacial till.

Loess, which is silty material transported by the wind, is the most extensive of the kinds of parent material in the county. The principal source of this material is probably the flood plain along the Mississippi River. The loess was transported after the retreat of the last glacier. The deepest deposits are in areas on the hills bordering the flood plain. Menfro, Winfield, and Weller soils formed in loess in these areas. Further from the source, the windblown deposits are thinner and contain more clay. In the prairie region of the county, the loess was deposited in areas on wide, nearly level or gently sloping divides where runoff is slow. Somewhat poorly drained and poorly drained soils formed in these areas. Examples are Putnam and Kilwinning soils. The deposits of loess on narrow ridgetops are thin. Gorin soils formed in loess and in the underlying glacial material on these ridgetops.

The soils on all of flood plains in the county formed in alluvium. Reflecting diverse origins and the varying speeds of flowing water, this material varies greatly in texture and in chemical and mineralogical composition. Local uplands are the only sources of the alluvium on flood plains along small tributary streams. The vast drainage system of the Mississippi River is the source of the alluvium on the flood plain along the Mississippi River in Lewis County. Darwin, Chequest, and other soils on this flood plain formed in material washed mainly from glacial deposits.

Local streams and drainageways that flow from the uplands have carried and deposited material on the smaller flood plains. Fatima and Blackoar are typical of the soils that formed in these deposits. They are high in content of silt, which is derived from the surrounding loess-capped uplands.

Plant and Animal Life

Organic matter is an important soil component. The decomposed remains of plants, animals, insects, bacteria, and fungi make up the organic fraction of the soil. Plants remove chemicals from the soil throughout the reach of their roots and translocate them to the growing parts of the plants above the soil. As they are later returned to the soil, leaves and other parts of plants decay and add nutrients and organic matter. Roots loosen soil aggregates. When they decay, they leave channels for the movement of water and air.

The kind of native vegetation has profoundly influenced soil formation in Lewis County. Prairie grasses and deciduous trees have markedly different rooting habits, lifespans, and kinds of minerals. Significant differences in micro-organisms and animals are associated with each.

Organic matter is added to soils that formed under forest vegetation mainly in the form of leaves, twigs, and logs, which decompose at the surface. These materials tend to be acid. They cause the formation of a very thin, dark surface layer and a leached subsurface layer.

The organic matter added to soils that formed under prairie grasses is mainly the weathered material derived from the yearly decay of annual and biennial plants. The tops of the plants decompose at the surface, but much of the organic material is added in the form of roots. The material thus added tends to be richer in minerals than forest residue. As a result, soils that formed under prairie grasses have a much thicker dark surface layer and tend to be less acid than soils that formed under forest vegetation.

Worms, insects, burrowing animals, and large animals affect soil formation. Bacteria and fungi are especially important. They cause the decay of organic material, improve tilth, and fix nitrogen in the soil. The population of soil organisms is directly related to the rate at which organic material decomposes in the soil. The kinds of organisms in a given area and their activity are determined by the kinds of vegetation.

In a remarkably short period, human activities have profoundly affected soil formation in Lewis County. The major effects have resulted from changes in vegetation, drainage, relief, and accelerated erosion. The prairie grasses have been replaced by row crops. Nearly all of the flood plains and many of the uplands have been cleared and are farmed. Chemicals have been used to improve the growth of desirable plants and to control unwanted plants and insects. Wet soils have been drained. Huge earthmoving equipment has completely rearranged soil profiles in areas used for urban development. Many of these changes have helped to increase the production of food and fiber. In terms of sustained productivity, however, the net effect of human activities has been adverse. Accelerated erosion continues to reduce the potential of many soils on uplands.

Climate

Climate has been an important factor affecting soil formation in Lewis County. It has markedly affected the nature and degree of weathering in the soils. Rainfall and temperature continue to affect soil formation. The rate of geologic erosion varies with the climate. It influences the shape and character of the landforms in a given area. Changes in the relative abundance and species composition of plant and animal life are affected by variations in climate. The present climatic conditions in the county favor the growth of trees at the expense of prairie grasses.

Changes in climate caused glacial periods. Thousands of years of cool temperatures resulted in the massive glaciers that moved into the county many years ago. As temperatures became warmer during later periods, severe geologic erosion occurred and the loess that covered most of Lewis County at one time was deposited. Extreme changes in climate occurred very slowly; therefore, there were long intermediate periods when different types of vegetation grew. Soils formed on the surface and were later covered by loess, truncated, and mixed by erosion or completely washed away. These processes occurred in areas of Armstrong and other soils.

High temperatures and abundant rainfall result in rapid chemical changes and physical disintegration. When calcium carbonates and other soluble salts are removed from the soil through leaching, the level of fertility is decreased. These climatic factors also result in the rapid breakdown of minerals and thus the formation of clay within the soil. The clay is moved downward, forming a subsoil. This process is known as eluviation. Nearly all of the soils on uplands in the county show the effects of high temperatures and abundant rainfall.

Relief

Relief, or lay of the land, affects soil formation through its effects on the patterns and forces of deposition. It is characterized by the gradient, length, shape, aspect, and uniformity of the slopes that make up a landscape. It is important in determining the pattern and distribution of soils on a landscape because of its influence on drainage, runoff, and erosion.

Relief varies greatly in Lewis County, ranging from that of the nearly level to moderately sloping prairie region to steep hillsides and vertical cliffs in dissected areas. If other factors are equal, more water penetrates the surface in nearly level areas than in the more sloping areas. As a result, leaching, the translocation of clay, and the other soil-forming processes are intensified in nearly level soils. Over long periods a subsoil high in content of clay has formed under a leached subsurface layer in Putnam and other soils.

In areas of Vanmeter and other moderately steep and steep soils, runoff is excessive and the rate of soil formation is slowed. Removal of the products of weathering by geologic erosion almost keeps pace with the accumulation of soil material through weathering.

Time

Time is necessary for the various processes of soil formation to act on the parent material. The time needed may be very short or very long. The age of a soil is determined by the degree of profile development rather than by the number of years that the soil material has been in place. It is a result of the interaction of the various soil-forming factors over periods of time. The soils in Lewis County vary widely in age.

Very young soils formed in alluvium deposited by floodwater receding from the flood plain along the Mississippi River. These are the youngest soils in the county. Blackoar, Fatima, and Kickapoo are examples.

The oldest soils in the county are those that formed in loess or glacial till in nearly level and gently sloping areas at the highest elevations. Examples are Putnam and Kilwinning soils. These soils are characterized by the maximum development of distinct horizons. The carbonates that were originally in their parent material have been leached to a great depth, leaving the soils quite acid throughout. Clay has concentrated in distinct layers in the subsoil, both through weathering and through translocation by water. A leached subsurface layer has formed in areas where a water table is perched above a relatively impervious subsoil.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range in moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-81 at Steffenville, Missouri)

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Temperature: Average number of growing degree days*	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	34.0	14.7	24.4	63	-15	0	1.40	0.43	2.19	4	7.2
February----	39.7	20.2	30.0	66	-11	14	1.28	.60	1.86	4	5.6
March-------	50.8	29.4	40.1	81	5	44	2.75	1.25	4.03	6	5.4
April-------	65.2	42.3	53.8	87	22	167	3.46	1.88	4.85	7	.9
May---------	74.6	51.8	63.2	91	33	416	4.24	2.63	5.68	8	.0
June--------	83.1	61.2	72.2	96	45	666	3.87	2.19	5.35	7	.0
July--------	87.9	65.4	76.7	100	49	828	4.52	1.97	6.69	6	.0
August------	85.9	62.9	74.4	99	48	756	3.79	1.68	5.58	5	.0
September---	79.2	54.7	67.0	95	35	510	3.69	1.44	5.60	6	.0
October-----	68.1	43.7	55.9	89	23	234	3.23	1.05	5.01	5	.1
November----	52.8	32.2	42.5	77	8	26	1.80	.61	2.77	4	1.7
December----	39.6	21.7	30.7	67	-9	0	1.54	.62	2.31	4	5.8
Yearly:											
Average---	63.4	41.7	52.6	---	---	---	---	---	---	---	---
Extreme---	---	---	---	102	-15	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,661	35.57	28.93	41.89	66	26.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-81 at Steffenville, Missouri)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 13	Apr. 20	May 5
2 years in 10 later than--	Apr. 9	Apr. 16	Apr. 30
5 years in 10 later than--	Mar. 31	Apr. 9	Apr. 21
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 22	Oct. 13	Sept. 30
2 years in 10 earlier than--	Oct. 27	Oct. 18	Oct. 5
5 years in 10 earlier than--	Nov. 5	Oct. 28	Oct. 14

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-81 at Steffenville, Missouri)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	198	182	156
8 years in 10	205	189	163
5 years in 10	218	201	175
2 years in 10	232	214	188
1 year in 10	239	220	195

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Arbela silt loam	4,300	1.3
2	Chariton silt loam	3,800	1.2
3	Blackoar silt loam	8,400	2.6
4	Darwin silty clay	4,700	1.4
5	Fatima silt loam	10,100	3.1
6	Kickapoo fine sandy loam	7,000	2.1
7C2	Gifford silt loam, 3 to 9 percent slopes, eroded	8,500	2.6
8B	Vigar loam, 2 to 5 percent slopes	1,950	0.6
9	Westerville silt loam	14,000	4.3
10C2	Leonard silty clay loam, 5 to 9 percent slopes, eroded	9,700	3.0
11C2	Armstrong loam, 5 to 9 percent slopes, eroded	28,250	8.6
12C	Gorin silt loam, 5 to 9 percent slopes	27,400	8.4
13E	Lindley loam, 14 to 20 percent slopes	24,000	7.4
13F	Lindley loam, 20 to 35 percent slopes	23,950	7.3
14	Chequest silty clay loam	5,050	1.6
15B	Kilwinning silt loam, 2 to 5 percent slopes	44,880	13.7
18	Putnam silt loam	15,250	4.7
20D2	Keswick clay loam, 9 to 14 percent slopes, eroded	39,250	12.0
21B	Weller silt loam, 2 to 5 percent slopes	1,400	0.4
22B	Menfro silt loam, 2 to 5 percent slopes	1,390	0.4
23C2	Winfield silt loam, 5 to 9 percent slopes, eroded	14,300	4.4
23D2	Winfield silt loam, 9 to 14 percent slopes, eroded	5,700	1.7
23E	Winfield silt loam, 14 to 25 percent slopes	2,500	0.8
24E	Vanmeter silt loam, 14 to 25 percent slopes	14,400	4.4
25	Moniteau silt loam	3,000	0.9
26B	Jasper loam, 1 to 7 percent slopes	1,750	0.5
27	Udipsamments, sloping	413	0.1
	Water	1,591	0.5
	Total	326,924	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
1	Arbela silt loam (where drained)
2	Chariton silt loam (where drained)
3	Blackoar silt loam (where drained)
4	Darwin silty clay (where drained)
5	Fatima silt loam
6	Kickapoo fine sandy loam (where protected from flooding or not frequently flooded during the growing season)
8B	Vigar loam, 2 to 5 percent slopes
9	Westerville silt loam (where drained)
14	Chequest silty clay loam (where drained)
15B	Kilwinning silt loam, 2 to 5 percent slopes (where drained)
18	Putnam silt loam (where drained)
21B	Weller silt loam, 2 to 5 percent slopes
22B	Menfro silt loam, 2 to 5 percent slopes
25	Moniteau silt loam (where drained)
26B	Jasper loam, 1 to 7 percent slopes

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchardgrass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
1------------- Arbela	IIw	103	41	90	45	3.9	7.7	7.7
2------------- Chariton	IIw	96	36	85	39	3.5	7.2	7.2
3------------- Blackoar	IIw	115	41	98	46	4.2	8.3	8.3
4------------- Darwin	IIIw	94	33	84	39	3.6	7.0	7.0
5------------- Fatima	IIw	121	45	106	49	4.5	9.0	9.0
6------------- Kickapoo	IIIw	65	25	59	27	2.5	5.0	5.0
7C2----------- Gifford	IIIe	79	28	64	30	2.9	5.5	5.5
8B------------ Vigar	IIe	121	41	106	49	4.5	9.0	9.0
9------------- Westerville	IIw	118	44	104	45	4.4	8.8	8.8
10C2---------- Leonard	IIIe	78	29	68	32	3.0	5.8	5.8
11C2---------- Armstrong	IIIe	83	32	72	34	3.0	6.2	6.2
12C----------- Gorin	IIIe	83	31	72	34	3.0	6.2	6.2
13E----------- Lindley	VIe	---	---	---	---	3.0	6.1	6.1
13F----------- Lindley	VIIe	---	---	---	---	---	5.5	5.5
14------------ Chequest	IIw	103	40	90	43	3.9	7.7	7.7
15B----------- Kilwinning	IIe	91	35	80	37	3.4	6.8	6.8
18------------ Putnam	IIw	96	37	85	40	3.7	7.2	7.2
20D2---------- Keswick	IVe	73	26	64	29	2.8	5.5	5.5
21B----------- Weller	IIe	96	35	85	40	3.7	5.5	5.5

See footnotes at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchardgrass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
22B------------- Menfro	IIe	108	40	94	44	4.0	8.0	8.0
23C2------------ Winfield	IIIe	102	37	89	41	3.8	7.5	7.5
23D2------------ Winfield	IIIe	92	34	80	37	3.4	6.8	6.8
23E------------- Winfield	IVe	86	32	75	35	3.3	6.5	6.5
24E------------- Vanmeter	VIIe	---	---	---	---	---	3.5	3.5
25-------------- Moniteau	IIIw	102	38	89	42	3.8	4.5	4.5
26B------------- Jasper	IIe	113	42	98	48	4.2	8.3	8.3
27**. Udipsamments								

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
3: Blackoar	4W	Slight	Severe	Moderate	Moderate	Pin oak	80	62	Pin oak, eastern cottonwood, pecan.
						Eastern cottonwood	95	116	
						Green ash	---	---	
4: Darwin	4W	Slight	Severe	Severe	Severe	Pin oak	80	62	Eastern cottonwood, American sycamore, green ash, pin oak.
						Eastern cottonwood	---	---	
						Green ash	---	---	
						American sycamore	---	---	
5: Fatima	5A	Slight	Slight	Slight	Slight	Pin oak	86	68	Pin oak, pecan, eastern cottonwood, American sycamore, black oak, black walnut.
						Black walnut	---	---	
						Bur oak	---	---	
6: Kickapoo	3W	Slight	Moderate	Slight	Slight	Northern red oak	66	48	Eastern cottonwood, green ash, silver maple, black walnut, northern red oak.
							---	---	
9: Westerville	5A	Slight	Slight	Slight	Slight	Pin oak	90	72	Pin oak, eastern cottonwood, green ash, pecan.
						Eastern cottonwood	100	128	
11C2: Armstrong	3C	Slight	Slight	Moderate	Severe	White oak	55	38	Eastern white pine, northern red oak, white oak.
						Northern red oak	55	38	
12C: Gorin	3C	Slight	Slight	Moderate	Severe	White oak	55	38	White oak, white ash, pin oak, black oak.
13E, 13F: Lindley	3R	Moderate	Moderate	Slight	Slight	White oak	60	43	White oak, white ash, black oak, northern red oak.
						Post oak	---	---	
						Black oak	---	---	
14: Chequest	7W	Slight	Severe	Slight	Slight	Eastern cottonwood	80	103	Eastern cottonwood, silver maple, American sycamore, green ash.
						Silver maple	90	34	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
20D2------------ Keswick	3C	Slight	Severe	Severe	Severe	White oak----------- Northern red oak----	55 55	38 38	Eastern white pine, northern red oak, white oak.
21B------------- Weller	3C	Slight	Slight	Moderate	Severe	White oak-----------	55	38	Eastern white pine, pine, black walnut, sugar maple.
22B------------- Menfro	3A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Black oak----------- White ash-----------	65 75 73 70	48 57 55 52	Black walnut, white ash, white oak, eastern white pine.
23C2, 23D2------ Winfield	3A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	65 60 65	48 43 48	Northern red oak, eastern white pine, white ash, black oak.
23E------------- Winfield	3R	Moderate	Moderate	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	65 60 65	48 43 48	Northern red oak, white ash, black oak.
24E------------- Vanmeter	2R	Moderate	Moderate	Moderate	Severe	White oak-----------	45	30	Eastern white pine.
25-------------- Moniteau	4W	Slight	Severe	Moderate	Moderate	Pin oak-------------	70	52	White oak, pin oak, green ash, eastern cottonwood, silver maple.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
1----------------- Arbela	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Washington hawthorn, northern whitecedar, blue spruce, white fir, Austrian pine.	Norway spruce-----	Pin oak, eastern white pine.
2----------------- Chariton	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
3----------------- Blackoar	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
4----------------- Darwin	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Austrian pine, northern whitecedar, blue spruce, Washington hawthorn, white fir.	Eastern white pine, Norway spruce.	Pin oak.
5----------------- Fatima	---	Amur honeysuckle, Amur privet, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
6----------------- Kickapoo	---	American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood.	Washington hawthorn, Austrian pine, blue spruce, northern whitecedar, white fir.	Norway spruce-----	Eastern white pine, pin oak.
7C2--------------- Gifford	---	Amur honeysuckle, Amur privet, eastern redcedar, arrowwood, Washington hawthorn, American cranberrybush.	Green ash, Austrian pine, Osageorange.	Pin oak, eastern white pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
8B---------------- Vigar	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
9----------------- Westerville	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	Austrian pine, white fir, northern whitecedar, blue spruce, Washington hawthorn.	Norway spruce-----	Pin oak, eastern white pine.
10C2-------------- Leonard	---	Amur honeysuckle, Amur privet, eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
11C2-------------- Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
12C--------------- Gorin	---	Amur honeysuckle, Washington hawthorn, eastern redcedar, Amur privet, arrowwood, American cranberrybush.	Green ash, Austrian pine, Osageorange.	Pin oak, eastern white pine.	---
13E, 13F---------- Lindley	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Washington hawthorn, northern whitecedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
14---------------- Chequest	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
15B: Kilwinning	---	Amur honeysuckle, Amur privet, American cranberrybush, arrowwood, Washington hawthorn, eastern redcedar.	Osageorange, green ash, Austrian pine.	Eastern white pine, pin oak.	---
18: Putnam	---	American cranberrybush, Amur honeysuckle, Amur privet, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
20D2: Keswick	---	Eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood, Amur privet, Amur honeysuckle.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
21B: Weller	---	American cranberrybush, Amur honeysuckle, arrowwood, Washington hawthorn, Amur privet, eastern redcedar.	Osageorange, green ash, Austrian pine.	Eastern white pine, pin oak.	---
22B: Menfro	---	Silky dogwood, Amur honeysuckle, Amur privet, American cranberrybush.	Northern whitecedar, Washington hawthorn, blue spruce, white fir.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
23C2, 23D2: Winfield	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	Northern whitecedar, blue spruce, white fir, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
23E. Winfield					
24E: Vanmeter	Siberian peashrub	Eastern redcedar, Osageorange, Russian olive, Washington hawthorn.	Northern catalpa, honeylocust, green ash.	---	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
25 Moniteau	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
26B Jasper	---	Silky dogwood, American cranberrybush, Amur honeysuckle, Amur privet.	Washington hawthorn, northern whitecedar, blue spruce, white fir.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
27*. Udipsamments					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1 Arbela	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
2 Chariton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
3 Blackoar	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
4 Darwin	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
5 Fatima	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
6 Kickapoo	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
7C2 Gifford	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: slope, wetness, percs slowly.	Severe: wetness.	Severe: wetness.
8B Vigar	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
9 Westerville	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
10C2 Leonard	Severe: wetness.	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.
11C2 Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
12C Gorin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Slight	Slight.
13E Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
13F Lindley	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14 Chequest	Severe: wetness, flooding.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
15B Kilwinning	Severe: percs slowly, wetness.	Severe: percs slowly.	Severe: percs slowly, wetness.	Moderate: wetness.	Moderate: wetness.
18 Putnam	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
20D2 Keswick	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
21B Weller	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
22B Menfro	Slight	Slight	Moderate: slope.	Slight	Slight.
23C2 Winfield	Slight	Slight	Severe: slope.	Slight	Slight.
23D2 Winfield	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
23E Winfield	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
24E Vanmeter	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
25 Moniteau	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
26B Jasper	Slight	Slight	Moderate: slope.	Slight	Slight.
27*. Udipsamments					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1: Arbela	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
2: Chariton	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
3: Blackoar	Good	Good	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
4: Darwin	Poor	Poor	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
5: Fatima	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
6: Kickapoo	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
7C2: Gifford	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
8B: Vigar	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
9: Westerville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
10C2: Leonard	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
11C2: Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
12C: Gorin	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
13E: Lindley	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
13F: Lindley	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
14: Chequest	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
15B: Kilwinning	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
18: Putnam	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
20D2: Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
21B: Weller	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hardwood trees	Conif- erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
22B----------------- Menfro	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
23C2, 23D2--------- Winfield	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
23E----------------- Winfield	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
24E----------------- Vanmeter	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
25------------------ Moniteau	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
26B----------------- Jasper	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
27*. Udipsamments										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1----------------- Arbela	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
2----------------- Chariton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, frost action.	Severe: wetness.
3----------------- Blackoar	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
4----------------- Darwin	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
5----------------- Fatima	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
6----------------- Kickapoo	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
7C2--------------- Gifford	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
8B---------------- Vigar	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
9----------------- Westerville	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
10C2-------------- Leonard	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
11C2-------------- Armstrong	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength.	Moderate: wetness.
12C--------------- Gorin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Slight.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
13E, 13F Lindley	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
14 Chequest	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, shrink-swell.	Moderate: wetness, flooding.
15B Kilwinning	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: low strength, shrink-swell.	Moderate: wetness.
18 Putnam	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
20D2 Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
21B Weller	Severe: wetness.	Severe: shrink-swell.	Severe: shrink-swell, wetness.	Severe: shrink-swell.	Severe: shrink-swell, frost action, low strength.	Slight.
22B Menfro	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
23C2 Winfield	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
23D2 Winfield	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
23E Winfield	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
24E Vanmeter	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
25 Moniteau	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
26B Jasper	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.	Slight.
27*. Udipsamments						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1 Arbela	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
2 Chariton	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
3 Blackoar	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
4 Darwin	Severe: flooding, ponding, percs slowly.	Severe: flooding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
5 Fatima	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
6 Kickapoo	Severe: flooding.	Severe: flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: too sandy.
7C2 Gifford	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
8B Vigar	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
9 Westerville	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
10C2 Leonard	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
11C2 Armstrong	Severe: percs slowly, wetness.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
12C Gorin	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Poor: thin layer.
13E, 13F Lindley	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: wetness, slope.	Severe: wetness, slope.	Poor: slope.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
14 Chequest	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: wetness, hard to pack, too clayey.
15B Kilwinning	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
18 Putnam	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, hard to pack, too clayey.
20D2 Keswick	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
21B Weller	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
22B Menfro	Slight	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
23C2 Winfield	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
23D2 Winfield	Severe: wetness.	Severe: slope, wetness.	Moderate: slope, wetness.	Moderate: slope, wetness.	Fair: too clayey, slope, wetness.
23E Winfield	Severe: wetness, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.
24E Vanmeter	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: slope.	Poor: area reclaim, hard to pack, slope.
25 Moniteau	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
26B Jasper	Slight	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey, thin layer.
27*. Udipsamments					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1 Arbela	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
2 Chariton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
3 Blackoar	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
4 Darwin	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
5 Fatima	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
6 Kickapoo	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
7C2 Gifford	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
8B Vigar	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
9 Westerville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
10C2 Leonard	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
11C2 Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
12C Gorin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
13E Lindley	Fair: wetness, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
13F Lindley	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
14 Chequest	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15B: Kilwinning	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
18: Putnam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
20D2: Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
21B: Weller	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
22B: Menfro	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
23C2: Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
23D2: Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
23E: Winfield	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
24E: Vanmeter	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope, too clayey.
25: Moniteau	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
26B: Jasper	Good	Probable	Improbable: too sandy.	Good.
27*. Udipsamments				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
1----------------- Arbela	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
2----------------- Chariton	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
3----------------- Blackoar	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness---------	Wetness.
4----------------- Darwin	Slight----------	Severe: hard to pack, ponding.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
5----------------- Fatima	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Flooding--------	Favorable-------	Favorable.
6----------------- Kickapoo	Moderate: seepage.	Slight----------	Deep to water	Soil blowing, flooding.	Too sandy, soil blowing.	Favorable.
7C2--------------- Gifford	Moderate: slope.	Severe: wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
8B---------------- Vigar	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Wetness, slope.	Wetness---------	Favorable.
9----------------- Westerville	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
10C2-------------- Leonard	Moderate: slope.	Severe: wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
11C2-------------- Armstrong	Moderate: slope.	Moderate: wetness, hard to pack.	Slope, percs slowly, frost action.	Slope, wetness, percs slowly.	Percs slowly, wetness.	Percs slowly, wetness.
12C--------------- Gorin	Moderate: slope.	Moderate: thin layer, piping, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
13E, 13F---------- Lindley	Severe: slope.	Moderate: piping, wetness.	Slope-----------	Wetness, slope.	Slope, wetness.	Slope.
14---------------- Chequest	Slight----------	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness, erodes easily.	Wetness, erodes easily.
15B--------------- Kilwinning	Moderate: seepage, slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly, wetness.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
18 Putnam	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
20D2 Keswick	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
21B Weller	Moderate: slope.	Moderate: hard to pack, wetness.	Slope, percs slowly, frost action.	Wetness, percs slowly, slope.	Wetness, erodes easily.	Percs slowly, erodes easily.
22B Menfro	Moderate: slope, seepage.	Slight	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
23C2 Winfield	Moderate: seepage, slope.	Moderate: thin layer, wetness.	Frost action, slope.	Slope, erodes easily.	Erodes easily, wetness.	Erodes easily.
23D2, 23E Winfield	Severe: slope.	Moderate: thin layer, wetness.	Frost action, slope.	Slope, erodes easily.	Slope, erodes easily, wetness.	Slope, erodes easily.
24E Vanmeter	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
25 Moniteau	Slight	Severe: wetness.	Frost action	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
26B Jasper	Severe: seepage.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
27*. Udipsamments						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1----------------- Arbela	0-13	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	13-22	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
	22-60	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	20-30
2----------------- Chariton	0-9	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	9-17	Silt loam--------	CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	17-51	Silty clay-------	CH	A-7	0	100	100	95-100	90-95	55-75	40-50
	51-60	Sandy clay loam, fine sandy loam, clay loam.	CL, SC, CL-ML, SM-SC	A-6, A-4	0	100	100	80-95	40-70	20-35	5-20
3----------------- Blackoar	0-14	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	14-60	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
4----------------- Darwin	0-12	Silty clay-------	CH, CL	A-7	0	100	100	100	90-100	45-85	25-55
	12-42	Silty clay, clay	CH, CL	A-7	0	100	100	100	85-100	45-85	25-55
	42-60	Silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	95-100	90-100	35-70	20-45
5----------------- Fatima	0-18	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	18-45	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	30-40	12-18
	45-60	Silt loam, loam	CL-ML, CL	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
6----------------- Kickapoo	0-5	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	100	70-85	40-55	<26	3-8
	5-60	Stratified silt loam to sand.	SM-SC, SC	A-4	0	100	100	65-75	35-45	<28	6-9
7C2--------------- Gifford	0-11	Silt loam--------	CL	A-6	0	100	100	90-100	85-95	30-40	10-20
	11-32	Silty clay-------	CH	A-7	0	100	100	95-100	95-100	50-65	30-40
	32-60	Silty clay loam, clay loam, loam.	CL	A-6, A-7	0	100	100	85-100	75-90	35-45	20-25
8B---------------- Vigar	0-26	Loam-------------	CL-ML, CL	A-4, A-6	0	95-100	90-100	85-95	60-75	20-30	5-15
	26-60	Clay loam, silty clay loam.	CL	A-6	0	95-100	90-100	80-95	70-90	30-40	15-25
9----------------- Westerville	0-19	Silt loam--------	ML, CL	A-6	0	100	100	95-100	85-100	30-40	10-20
	19-60	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	85-100	80-100	30-45	10-20
10C2-------------- Leonard	0-7	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	85-100	30-45	15-25
	7-30	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	20-30
	30-60	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	95-100	95-100	80-95	75-90	45-60	25-35
11C2-------------- Armstrong	0-6	Loam-------------	CL, CL-ML	A-6, A-4	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	6-54	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	54-60	Clay loam--------	CL	A-6	0-5	90-100	80-95	70-90	55-80	30-40	15-20
12C--------------- Gorin	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-18
	6-13	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	13-24	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	24-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	80-95	70-90	30-50	12-30

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
13E, 13F--------- Lindley	0-7	Loam-------------	CL	A-6	0	95-100	90-100	85-95	50-65	25-35	10-15
	7-46	Clay loam, loam	CL	A-6, A-7	0	95-100	90-100	85-95	55-75	30-45	10-20
	46-60	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	50-70	25-35	10-15
14--------------- Chequest	0-17	Silty clay loam	CL	A-7	0	100	100	95-100	95-100	40-50	15-25
	17-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	45-60	20-30
15B-------------- Kilwinning	0-9	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-40	5-15
	9-31	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	55-70	35-45
	31-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-55	20-30
18--------------- Putnam	0-9	Silt loam--------	CL, ML	A-6, A-4	0	100	100	90-100	85-100	30-40	5-15
	9-17	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	30-40	5-15
	17-37	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	60-70	35-45
	37-60	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	90-100	50-65	25-40
20D2------------- Keswick	0-4	Clay loam--------	CL	A-6, A-7	0-5	90-100	80-100	75-90	60-80	35-50	15-25
	4-33	Clay loam, clay	CH, CL	A-7	0-5	90-100	80-100	70-90	55-80	40-70	20-40
	33-60	Clay loam--------	CL	A-6	0-5	90-100	80-100	70-90	55-80	30-40	15-25
21B-------------- Weller	0-17	Silt loam--------	ML, CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	17-51	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	45-65	30-40
	51-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	100	100	100	95-100	30-55	10-30
22B-------------- Menfro	0-13	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	25-35	11-20
	13-43	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	43-60	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
23C2, 23D2, 23E-- Winfield	0-6	Silt loam--------	CL	A-6	0	100	100	95-100	90-100	25-40	10-20
	6-10	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	15-25
	10-44	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	20-25
	44-60	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	90-100	25-35	5-15
24E-------------- Vanmeter	0-5	Silt loam--------	CL, CL-ML	A-4, A-6	0-5	95-100	75-100	70-100	65-100	25-40	5-15
	5-10	Silty clay loam, clay loam.	CL, CH	A-7	0-5	95-100	75-100	70-100	65-100	40-55	15-30
	10-32	Silty clay, clay	CH, CL	A-7	0-5	95-100	75-100	70-100	65-100	40-65	24-40
	32-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
25--------------- Moniteau	0-18	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	18-48	Silty clay loam	CL	A-6, A-7	0	100	100	85-100	80-95	30-45	15-25
	48-60	Silt loam, silty clay loam.	CL-ML, CL, ML	A-4, A-6	0	100	100	85-100	75-100	25-40	5-15
26B-------------- Jasper	0-10	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	10-20	Silt loam, loam	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	15-35	4-15
	20-53	Loam, clay loam, sandy clay loam.	CL-ML, CL, SM-SC, SC	A-4, A-6	0	100	100	60-100	35-85	20-35	5-20
	53-60	Loamy sand, sand	SM, SP-SM, SC, SM-SC	A-2-4, A-3	0	100	100	50-75	5-30	<25	NP-10
27*. Udipsamments											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
1----------------- Arbela	0-13	20-27	1.30-1.50	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.32	5	6	2-4
	13-22	18-27	1.35-1.55	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.43			
	22-60	35-40	1.30-1.40	0.2-0.6	0.18-0.20	4.5-6.0	Moderate------	0.43			
2----------------- Chariton	0-9	18-27	1.35-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Low-----------	0.37	3	6	1-4
	9-17	15-24	1.35-1.50	0.6-2.0	0.20-0.22	5.1-6.5	Low-----------	0.37			
	17-51	48-60	1.35-1.45	0.06-0.2	0.11-0.13	5.1-7.3	High----------	0.28			
	51-60	15-35	1.40-1.55	0.6-2.0	0.15-0.18	6.1-7.8	Moderate------	0.32			
3----------------- Blackoar	0-14	18-27	1.35-1.45	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.28	5	6	2-4
	14-60	18-27	1.35-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.43			
4----------------- Darwin	0-12	40-45	1.20-1.40	<0.06	0.11-0.14	6.1-7.8	Very high-----	0.28	5	4	4-5
	12-42	45-60	1.30-1.50	<0.06	0.11-0.14	6.1-7.8	Very high-----	0.28			
	42-60	30-55	1.40-1.60	0.06-0.2	0.10-0.20	6.6-8.4	High----------	0.28			
5----------------- Fatima	0-18	15-27	1.30-1.45	0.6-2.0	0.22-0.24	6.1-7.3	Low-----------	0.28	5	6	2-4
	18-45	18-27	1.35-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28			
	45-60	18-27	1.35-1.55	0.6-2.0	0.20-0.22	6.1-7.3	Low-----------	0.28			
6----------------- Kickapoo	0-5	8-16	1.20-1.55	0.6-2.0	0.16-0.18	5.1-7.8	Low-----------	0.24	5	3	2-4
	5-60	12-18	1.50-1.60	0.6-2.0	0.12-0.16	5.1-7.8	Low-----------	0.24			
7C2--------------- Gifford	0-11	20-27	1.30-1.45	0.6-2.0	0.22-0.24	5.1-6.5	Low-----------	0.43	3	6	1-4
	11-32	45-60	1.30-1.45	<0.06	0.11-0.14	5.1-7.3	High----------	0.32			
	32-60	25-35	1.35-1.50	0.06-0.2	0.18-0.20	5.6-7.3	Moderate------	0.43			
8B---------------- Vigar	0-26	15-27	1.25-1.45	0.6-2.0	0.20-0.22	5.6-6.5	Low-----------	0.24	5	5	2-4
	26-60	27-35	1.20-1.40	0.2-0.6	0.14-0.16	5.6-7.3	Moderate------	0.32			
9----------------- Westerville	0-19	18-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-5.5	Low-----------	0.37	5	6	1-2
	19-60	18-35	1.30-1.40	0.6-2.0	0.18-0.20	5.1-6.0	Low-----------	0.37			
10C2-------------- Leonard	0-7	27-35	1.20-1.40	0.2-0.6	0.22-0.24	6.1-7.3	Moderate------	0.37	3	7	.5-2
	7-30	35-45	1.30-1.45	0.06-0.2	0.11-0.13	4.5-6.5	High----------	0.37			
	30-60	32-45	1.25-1.40	0.06-0.2	0.11-0.14	6.6-7.8	High----------	0.37			
11C2-------------- Armstrong	0-6	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate------	0.32	3	6	2-3
	6-54	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High----------	0.32			
	54-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.3	Moderate------	0.32			
12C--------------- Gorin	0-6	12-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate------	0.43	3	6	.5-2
	6-13	27-42	1.30-1.45	0.06-0.6	0.18-0.20	4.5-6.0	Moderate------	0.32			
	13-24	35-60	1.30-1.40	0.06-0.2	0.11-0.16	4.5-6.0	High----------	0.32			
	24-60	27-40	1.30-1.45	0.2-0.6	0.18-0.20	4.5-6.0	Moderate------	0.32			
13E, 13F---------- Lindley	0-7	18-27	1.20-1.40	0.6-2.0	0.16-0.18	4.5-7.3	Low-----------	0.32	5	6	1-2
	7-46	25-35	1.35-1.55	0.2-0.6	0.14-0.18	4.5-6.5	Moderate------	0.32			
	46-60	18-32	1.40-1.60	0.2-0.6	0.12-0.16	6.1-7.8	Moderate------	0.32			
14---------------- Chequest	0-17	30-35	1.30-1.35	0.2-0.6	0.18-0.20	5.1-7.3	High----------	0.28	5	7	3-4
	17-60	35-42	1.35-1.45	0.2-0.6	0.14-0.18	5.1-6.0	High----------	0.43			
15B--------------- Kilwinning	0-9	15-27	1.35-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.37	3	6	2-4
	9-31	35-55	1.30-1.40	<0.06	0.11-0.13	4.5-6.0	High----------	0.37			
	31-60	35-55	1.30-1.40	0.06-0.2	0.18-0.20	5.6-7.3	Moderate------	0.37			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
18----------------- Putnam	0-9	12-27	1.30-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low-----------	0.43	3	6	.5-3
	9-17	12-27	1.30-1.50	0.6-2.0	0.20-0.22	4.5-6.5	Low-----------	0.43			
	17-37	48-60	1.20-1.40	<0.06	0.09-0.11	3.6-5.5	High----------	0.32			
	37-60	35-48	1.25-1.45	0.06-0.2	0.12-0.16	3.6-5.5	High----------	0.43			
20D2--------------- Keswick	0-4	27-40	1.45-1.50	0.2-0.6	0.17-0.19	4.5-7.3	Moderate------	0.37	3-2	4	.5-1
	4-33	35-60	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High----------	0.37			
	33-60	30-40	1.60-1.75	0.2-0.6	0.12-0.16	4.5-7.3	Moderate------	0.37			
21B---------------- Weller	0-17	16-27	1.35-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Low-----------	0.43	3	6	1-2
	17-51	28-48	1.35-1.50	0.06-0.2	0.12-0.18	4.5-6.0	High----------	0.43			
	51-60	25-40	1.40-1.55	0.2-0.6	0.18-0.20	5.1-6.0	High----------	0.43			
22B---------------- Menfro	0-13	18-27	1.25-1.40	0.6-2.0	0.22-0.24	5.1-7.3	Low-----------	0.37	5	6	.5-2
	13-43	27-33	1.35-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate------	0.37			
	43-60	8-20	1.30-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.37			
23C2, 23D2, 23E-- Winfield	0-6	20-27	1.30-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.37	5	6	.5-2
	6-10	25-30	1.30-1.50	0.6-2.0	0.18-0.22	5.6-7.3	Moderate------	0.37			
	10-44	27-35	1.30-1.50	0.6-2.0	0.18-0.20	4.5-6.0	Moderate------	0.37			
	44-60	20-27	1.30-1.50	0.6-2.0	0.20-0.22	5.1-6.0	Low-----------	0.37			
24E---------------- Vanmeter	0-5	18-27	1.30-1.40	0.2-0.6	0.18-0.20	6.1-8.4	Low-----------	0.43	3	4L	1-2
	5-10	27-40	1.30-1.40	0.2-0.6	0.14-0.16	6.1-8.4	Moderate------	0.32			
	10-32	40-60	1.50-1.60	<0.06	0.12-0.14	6.1-8.4	High----------	0.32			
	32-60	---	---	---	---	---	--------------	----			
25----------------- Moniteau	0-18	18-27	1.20-1.40	0.6-2.0	0.21-0.23	5.1-7.3	Low-----------	0.43	5	6	1-2
	18-48	27-35	1.30-1.50	0.2-0.6	0.18-0.20	4.5-6.0	Moderate------	0.43			
	48-60	18-30	1.25-1.45	0.2-0.6	0.20-0.22	4.5-6.5	Low-----------	0.43			
26B---------------- Jasper	0-10	10-22	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low-----------	0.28	5-4	5	1-2
	10-20	10-22	1.35-1.55	0.6-2.0	0.17-0.22	5.1-7.3	Low-----------	0.28			
	20-53	20-32	1.40-1.60	0.6-2.0	0.13-0.19	5.1-6.5	Low-----------	0.28			
	53-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.1-7.8	Low-----------	0.17			
27*. Udipsamments											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
1----------------- Arbela	C	Occasional	Brief-----	Nov-May	0-1.5	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
2----------------- Chariton	C	None---------	---	---	0-1.5	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
3----------------- Blackoar	B/D	Occasional	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
4----------------- Darwin	D	Occasional	Brief-----	Nov-May	+1-2.0	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
5----------------- Fatima	B	Occasional	Brief-----	Nov-May	3.0-5.0	Apparent	Nov-May	>60	---	High-----	Moderate	Low.
6----------------- Kickapoo	B	Frequent----	Brief-----	Nov-May	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
7C2--------------- Gifford	D	Rare---------	---	---	0.5-2.0	Perched	Nov-May	>60	---	Moderate	High-----	Moderate.
8B---------------- Vigar	C	Rare---------	---	---	2.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
9----------------- Westerville	B	Occasional	Brief-----	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	Moderate	Moderate.
10C2-------------- Leonard	D	None---------	---	---	0.5-2.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
11C2-------------- Armstrong	C	None---------	---	---	1.0-3.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
12C--------------- Gorin	C	None---------	---	---	2.0-4.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
13E, 13F---------- Lindley	C	None---------	---	---	2.0-3.5	Apparent	Nov-May	>60	---	Moderate	Moderate	Moderate.
14---------------- Chequest	C	Occasional	Brief-----	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
15B---------------- Kilwinning	D	None---------	---	---	1.0-2.0	Perched	Nov-May	>60	---	Moderate	High------	Moderate.
18----------------- Putnam	D	None---------	---	---	0.5-1.5	Perched	Nov-May	>60	---	Moderate	High------	High.
20D2--------------- Keswick	C	None---------	---	---	1.0-3.0	Perched	Nov-May	>60	---	High------	High------	Moderate.
21B---------------- Weller	C	None---------	---	---	2.0-4.0	Perched	Nov-May	>60	---	High------	High------	High.
22B---------------- Menfro	B	None---------	---	---	>6.0	---	---	>60	---	High------	Low-------	Moderate.
23C2, 23D2, 23E--- Winfield	B	None---------	---	---	2.5-4.0	Perched	Nov-May	>60	---	High------	Moderate	Moderate.
24E---------------- Vanmeter	C	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Low.
25----------------- Moniteau	C/D	Rare---------	---	---	0-1.0	Apparent	Nov-May	>60	---	High------	High------	High.
26B---------------- Jasper	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
27*. Udipsamments												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Arbela	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Armstrong	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Blackoar	Fine-silty, mixed, mesic Fluvaquentic Haplaquolls
Chariton	Fine, montmorillonitic, mesic Mollic Albaqualfs
Chequest	Fine, montmorillonitic, mesic Typic Haplaquolls
Darwin	Fine, montmorillonitic, mesic Vertic Haplaquolls
Fatima	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Gifford	Fine, montmorillonitic, mesic Vertic Ochraqualfs
Gorin	Fine, montmorillonitic, mesic Aquic Hapludalfs
Jasper	Fine-loamy, mixed, mesic Typic Argiudolls
Keswick	Fine, montmorillonitic, mesic Aquic Hapludalfs
Kickapoo	Coarse-loamy, mixed, nonacid, mesic Typic Udifluvents
Kilwinning	Fine, montmorillonitic, mesic Vertic Ochraqualfs
Leonard	Fine, montmorillonitic, mesic, sloping Vertic Ochraqualfs
Lindley	Fine-loamy, mixed, mesic Typic Hapludalfs
Menfro	Fine-silty, mixed, mesic Typic Hapludalfs
Moniteau	Fine-silty, mixed, mesic Typic Ochraqualfs
Putnam	Fine, montmorillonitic, mesic Mollic Albaqualfs
Udipsamments	Mixed, mesic Udipsamments
Vanmeter	Fine, illitic, mesic Typic Eutrochrepts
Vigar	Fine-loamy, mixed, mesic Aquic Argiudolls
Weller	Fine, montmorillonitic, mesic Aquic Hapludalfs
Westerville	Fine-silty, mixed, acid, mesic Aeric Fluvaquents
Winfield	Fine-silty, mixed, mesic Typic Hapludalfs

Accessibility Statement

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